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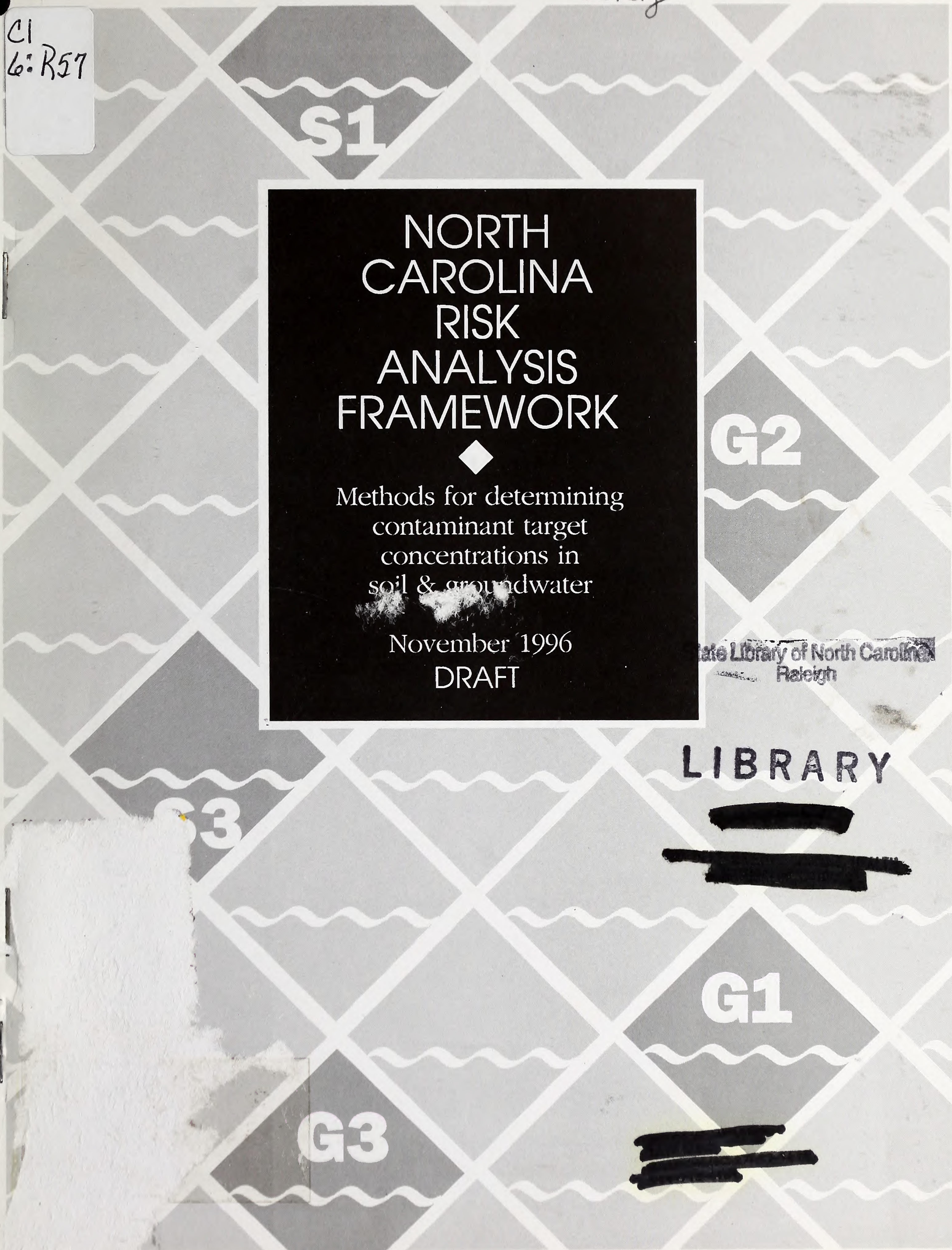

NORTH CAROLINA RISK ANALYSIS FRAMEWORK

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Methods for determining contaminant target concentrations in soil & groundwater

November 1996

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SUMMARY OF RISK ANALYSIS FRAMEWORK

In 1994, the Pollution Prevention Advisory Council (PPAC) made a recommendation that a working group be established within the Department of Environment, Health and Natural Resources (DEHNR) to review and approve consistent risk assessment procedures and to evaluate alternatives. As a result, a working group ("the Working Group") was formed in June 1995 to fulfill this recommendation. Members were recruited from DEHNR divisions involved in protection of human health and the environment, and regulation of locations where groundwater or soil may have been adversely affected by environmental contamination.

The main issue expressed by the PPAC in its recommendations was that there is little consistency among DEHNR divisions regarding how to conduct a risk assessment. The Working Group identified risk assessment as the evaluation of scientific information on the hazardous properties of environmental agents, the doses of the agents that may cause adverse effects and the extent of human and environmental exposure to those agents. A risk assessment is a statement of the probability that populations and environments so exposed will be harmed.

This document describes procedures for determining acceptable contaminant target concentrations (the contaminant concentration at which no further clean-up actions are required based upon the risk of harm posed by the contaminant) and assessing the risk of harm to human health, the environment and public welfare. These procedures will promote consistent decision-making for locations regulated by DEHNR where soil or groundwater may have been adversely affected by environmental contamination. Locations at which this framework may be used include, but are not limited to hazardous waste sites, inactive hazardous sites, inactive and active municipal solid waste sites, leaking underground storage tanks, and spill sites. Sites with radiation contamination must first contact the Division of Radiation Protection.

It is intended that this document be used as a framework for the divisions to determine acceptable target concentrations, conduct site-specific risk assessments and choose management strategies within the limit of their regulatory authority. Information obtained by following the procedures may be used in determining the need for and extent of clean-up of contamination. In addition, use of this document can help to focus regulatory oversight and resources on the most hazardous sites and expedite closure at lower risk sites.

Contaminated site conditions vary greatly with respect to the physical and chemical characteristics of the contaminants, hydrogeologic setting, distribution of contamination, and physical characteristics of the site. Therefore, contaminated sites also vary in the degree of risk they pose to human health and the environment. This document presents a streamlined tiered approach (Methods I, II, and III) for evaluating risk. Each successive tier (or method) uses more site-specific information to determine the target concentrations for groundwater and soil.

- o Method I involves the use of "look-up" tables of non-site-specific target concentrations that are pre-calculated by the Department.
- o Method II allows the responsible party to calculate target concentrations using some site-specific data and specified models and equations.
- o Method III builds on Method II by allowing models other than those presented in Method II to be used in calculating the target concentrations.

To choose a method, the responsible party must balance the cost of collecting additional data with the potential cost savings of less conservative target concentrations. The cost of applying institutional controls, such as deed restrictions, which may be required at sites using the less conservative target concentrations should also be considered.

As an alternative to Methods I, II and III, a responsible party may elect to use a site-specific risk assessment to determine the total risk posed by the contamination to each receptor (any human, plant or animal that has the potential to be adversely affected by the release or migration of contaminants). All contaminated media, migration pathways, exposure situations and receptors must be considered. The total risk is then compared to the acceptable target risk to determine what, if any, action is appropriate. Under some programs, a comprehensive, site-specific risk assessment may be required, such as when unaddressed exposure situations exist. Site-specific risk assessments may also be required for sites with multiple contaminants and multiple exposures.

The process of determining the risk of adverse impacts to human health and the environment at a contaminated site involves the identification and characterization of potential exposures (contact of an organism with a chemical or physical agent), migration pathways (routes by which a contaminant is transported at or from the site of a release), and receptors. For groundwater, the most common exposures are ingestion through drinking and inhalation of contaminant vapors. One of the most common migration pathways is the transport of groundwater contaminants to surface water. For soil, the most common exposures are ingestion (eating) of soil by children or adult residents (known as "residential exposure") and ingestion of soil by adult workers (known as "industrial/commercial exposure"). One of the most common migration pathways for soil contaminants is the transport from soil to groundwater.

In Methods I, II and III, target concentration determination requires the use of three groundwater categories and three soil categories. These categories are based on the common exposure situations and migration pathways described above. The categories are:

GROUNDWATER CATEGORIES

G-1 -	current or potential drinking water and current or potential non-drinking water exposures such as from swimming pools or irrigation;
G-2 -	transport of contaminant vapors from groundwater to indoor air; and
G-3 -	transport of groundwater contaminants to surface water.

SOIL CATEGORIES

S-1 -	residential ingestion of soil;
S-2 -	industrial/commercial ingestion of soil; and
S-3 -	transport of soil contaminants to groundwater.

Target concentrations must be determined for each applicable category. The lowest groundwater and soil target concentrations for the applicable categories will be the target concentrations for the site. If the maximum contaminant concentrations detected at a site are less than or equal to the target concentrations, the site may be considered to pose no significant risk. However, if the maximum concentrations exceed the target concentrations, the site is considered to pose an unacceptable risk and action must be taken by the responsible party to reduce the risk to acceptable levels.

Under the risk analysis framework, site closure may be achieved if it is determined that the contamination at a site poses no significant risk to human health or the environment. However, to close sites with contamination remaining at levels above the G-1 (current or potential drinking/non-drinking water exposure) target concentrations for groundwater or S-1 (residential) target concentrations for soil, it will be necessary to use some form(s) of institutional control to ensure that the assumptions concerning current and future receptors and uses of the site remain the same.

Institutional controls generally include one or more of the following measures: deed restrictions, restrictive covenants, use restrictions, notice, Registry Act requirements and Property Transfer Act requirements. Use of institutional controls will serve to provide notification of the environmental status of a property to prospective property owners, tenants and the general public.

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ACRONYMS

ASTM	- American Society for Testing and Materials
CCL	- Ceiling Concentration Limits
CFR	- Code of Federal Regulations
DEHNR	- Department of Environment, Health, and Natural Resources
DMF	- Division of Marine Fisheries
DWM	- Division of Waste Management
DWQ	- Division of Water Quality
EPA	- Environmental Protection Agency
FWS	- Future Water Supply
HQW	- High Quality Waters
IRIS	- Integrated Risk Information System
MDL	- Method Detection Limit
NC	- North Carolina
NCAC	- North Carolina Administrative Code
NOAA	- National Oceanic and Atmospheric Administration
NPDES	- National Pollutant Discharge Elimination System
ORW	- Outstanding Resource Waters
PAH	- Polynuclear Aromatic Hydrocarbon
PLE	- Plume's Leading Edge
PPAC	- Pollution Prevention Advisory Council
QA/QC	- Quality Assurance/Quality Control
QL	- Quantification Limit
RAGS	- Risk Assessment Guidance for Superfund
RBPWG	- Risk-Based Protocol Working Group (the Working Group)
RCRA	- Resource Conservation and Recovery Act
RfC	- Reference Concentration
RfD	- Reference Dose
TEF	- Toxicity Equivalency Factor
TPH	- Total Petroleum Hydrocarbons
Tr	- Designated Trout Waters
USGS	- United States Geological Society
UST	- Underground Storage Tank
WRC	- Wildlife Resources Commission

GLOSSARY

Anthropogenic Background Levels - the concentrations of chemicals that are consistently present in the environment at and in the vicinity of the site due to human-made, non-site sources (e.g., industry, automobiles). Examples of these chemicals include polycyclic aromatic hydrocarbons (PAHs) and lead.

Background Levels - the concentrations of chemicals that are consistently present in the environment at and in the vicinity of the site which are naturally occurring (attributable to natural conditions) or anthropogenic (due to human-made, non-site sources). See naturally occurring and anthropogenic background levels.

Calculated Source Concentration - contaminant concentrations predicted by a transport model to be protective of nearby groundwater, surface water or indoor air.

Cancer Slope Factors - a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

Ceiling Concentration Limit - a concentration set by the Department that is an upper limit on the amount of contamination that can remain in groundwater or soil at a site.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - an act of Congress, commonly called the Superfund Law, that addresses the clean-up of and liability for abandoned, bankrupt, illegal, historical or otherwise unregulated disposal of hazardous substances. Regulations regarding CERCLA are found at 40 CFR 300.

Clean-up Actions - a set of actions including remediation, corrective action or interim measures, taken to eliminate sources of environmental contamination, restore environmental quality or minimize exposure (e.g., fences, warning signs). The type of clean-up actions taken are done pursuant to applicable regulatory program rules and guidance documents.

Closure - for purposes of this document, refers to the management step where further investigation and remedial action at a site or facility are ended, and the regulatory oversight requirements are greatly reduced or eliminated.

Congeners - for purposes of this document, a group of chemicals with like structure.

Contaminant Target Concentration - the concentration of a contaminant at which no further clean-up or control actions are required based upon the risk of harm posed by the contaminant.

Contamination - for purposes of this document, the act, process or occurrence of a contaminant in groundwater, surface water, soils or indoor air.

Control Actions - measures taken to prevent the migration of contamination such as pumping of groundwater to maintain hydraulic control or using an engineered barrier. Control actions may also include fences, warning signs, etc. to limit access to a site.

Current Site Activities and Uses - any human or environmental pursuits presently taking place or that could reasonably take place at and in the vicinity of the site which have the potential to result in exposure of human or environmental receptors to contaminants.

Department - the Department of Environment, Health and Natural Resources.

Environmental Receptor - any living organism other than humans, the habitat which supports such organisms, or a natural resource which could be adversely affected by environmental contamination as the result of a release to the environment.

Exposure - contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut) and available for absorption.

Exposure Assessment - an estimate of the extent of the exposure to which the populations of interest may be subject.

Exposure Duration - the length of time populations of interest may be exposed to a contaminant.

Groundwater - those waters occurring in the subsurface under saturated conditions.

Groundwater Plume Leading Edge - the location, based on contaminant analytical data, of the first measurable contaminant concentration that is less than the surface water quality standard down-gradient of the point of maximum contaminant concentration.

Groundwater Plume Length - the distance from the groundwater plume leading edge to the groundwater plume trailing edge parallel to the direction of groundwater flow.

Groundwater Plume Trailing Edge - the location, based on contaminant analytical data, of the first measurable contaminant concentration that is less than the surface water quality standard up-gradient of the point of maximum contaminant concentration.

Groundwater Quality Standards - measures of the quality of groundwater as established in 15A NCAC 2L .0200 per G.S. 143-214.1.

Habitat - the area or type of environment in which an organism or biological population normally lives or interacts.

Hazard Index - the sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. The HI is calculated separately for chronic, subchronic, and shorter duration exposures.

Hazard Quotient - the ratio of a single substance exposure level over a specified time period (e.g., subchronic) to a reference dose for that substance derived from a similar exposure period.

Hazardous Waste - as defined in the federal regulations, a solid waste, or combination of solid wastes, which because of its quantity, concentration, physical, chemical or infectious characteristics may:

- Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or
- Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

As defined in the federal regulations, a solid waste is hazardous if it meets one of three conditions:

- Exhibits a characteristic of a hazardous waste (40 CFR Sections 261.20 through 261.24);
- Has been listed as hazardous (40 CFR Sections 261.31 through 261.33); or
- Is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of a hazardous waste).

Human Receptor - a human being who is presently or will potentially be exposed to, and adversely affected by, contaminants as a result of a release to the environment.

Interim Standard - the interim maximum allowable concentration determined per 15A NCAC 2L .0200, if no groundwater quality standard is available for a contaminant.

Leachate - a liquid, usually rainwater or other precipitation, that moves through soil and subsurface media and collects contaminants as it percolates through or is drained from sites where:

- spills, releases, or permit violations have occurred; or
- where hazardous wastes, petroleum products, solid wastes, pesticides or animal wastes are stored, treated, deposited, buried, or disposed of.

Media - specific environments (air, water, soil, sediment, etc.) that are the subject of regulatory concern and activities.

Method Detection Limit - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR 136 Appendix B).

Migration Pathway - the route by which a contaminant is transported at or from the site of a release.

Naturally Occurring Background Levels - concentrations of chemicals that are consistently present in the environment at and in the vicinity of the site which are attributable to natural (non-anthropogenic) sources (i.e. geologic or ecological conditions). Examples of these chemicals include aluminum and manganese.

NPDES - National Pollutant Discharge Elimination System - This system is used by the states and EPA to regulate direct discharges of contaminants to surface water.

Potable Water - waters suitable for drinking by humans.

Preferred Pathway - the route by which a contaminant is most easily transported at or from the site of a release. Examples of preferred pathways for the transport of contaminants include porous or fractured geologic materials, natural drainageways and man-made structures such as utility lines, pipelines, sewers and ditches.

Quantitation Limit - the lowest concentration of a given material that can be reliably achieved within specified limits of precision and accuracy by a given analytical method during routine laboratory analysis.

Reasonably Foreseeable Site Activities and Uses - any human or environmental pursuits that could occur in the future at and in the vicinity of the site which could result in exposure to human or environmental receptors.

Receptor - any human, plant or animal that is or has the potential to be adversely affected by the release or migration of contaminants.

Reference Dose (RfD) - an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic Reference Doses (Chronic RfDs) are specifically developed to be protective for long-term exposure to a compound.

Remedial Actions - actions taken by a remediating party to manage, control or reduce risk associated with environmental contamination which includes remediation (clean-up), engineering controls, and institutional controls.

Responsible Party - any person or entity that is required by the DEHNR to proceed with investigation/clean-up, or that chooses to conduct an investigation/clean-up of a contaminated site.

Resource, Conservation and Recovery Act (RCRA) - the Resource Conservation and Recovery Act of 1976 and subsequent amendments (1980 and 1984) found in 40 CFR 240-271. Major emphasis of this act is on control of hazardous waste disposal. It establishes a system to identify wastes and track their generation, transport, and ultimate disposal.

Risk Analysis - procedures for determining contaminant target concentrations and assessing risk of harm to human health, the environment and public welfare.

Risk Assessment - the evaluation of scientific information on the hazardous properties of environmental agents, the doses of agents that may cause adverse effects, and the extent of human and environmental exposure to those agents.

Risk Characterization - the process of integrating hazard identification, dose-response assessment and exposure assessment to describe the nature and magnitude of health risk.

Risk Management - the process by which risk assessment results are integrated with other information to make decisions about the need for, method of and extent of risk reduction.

Site - area(s) where oil or hazardous substance has been deposited, stored, disposed, or placed, or has otherwise come to be located. Such areas may include multiple sources and may include the area between sources.

Solubility - the amount of a pure substance that will dissolve in a given amount of liquid. Solubility is usually expressed as milligram of solute per liter of water (mg/l).

Surface Water - waters of the State as defined in G.S. 143-212 excluding those defined as groundwater.

Surface Water Quality Standard - measures of the quality of surface water as established in 15A NCAC 2B .0200 per G.S. 143-214.1.

Target Concentration - see contaminant target concentration.

Toxicity Equivalency Factors (TEF) - factors used in the toxicity assessment for chlorinated dioxins, furans and carcinogenic polycyclic aromatic hydrocarbons. The TEFs for each dioxin and furan congener presented in the protocol document expresses the potency relative to 2,3,7,8 - Tetrachlorodibenzo-p-dioxin (TCDD). TEFs available for each dioxin and furan congener can be used to calculate target concentrations or to assess the risk for each. Similarly the TEF methodology is used to determine clean-up levels or to conduct risk assessments for carcinogenic polycyclic aromatic hydrocarbons (cPAHs). The TEFs for each cPAH presented in the protocol document express the relative potency of these chemicals to Benzo(a)pyrene.

Toxicity Value - a numerical expression of a substance's dose response relationship that is used in risk assessments. The most common toxicity values are reference doses for non-carcinogenic effects and slope factors for carcinogenic effects.

Unit Risk Factors - the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 microgram per liter in water, or 1 microgram per cubic meter in air.

Working Group - the Risk Based Protocol Working Group established by the Department pursuant to the 1994 Pollution Prevention Advisory Council Recommendation # 28.

CHAPTER 1 - INTRODUCTION

A. Background

Risk assessments have been increasingly relied upon by those who manage sites with environmental contamination. Risk assessment is a scientific method for predicting adverse effects of hazardous materials on individuals and the environment that is used to assist in making management decisions related to clean-up of contaminated sites, property transactions and long-term liability issues. Determining the risk presented by a site can help to focus regulatory oversight and resources on the most hazardous sites and expedite closure at lower risk sites.

Several divisions of the Department of Environment, Health and Natural Resources (DEHNR or the Department) already use risk assessment. However, according to the Pollution Prevention Advisory Council (PPAC) final report from 1994, there is little consistency in its application within the Department. The PPAC's recommendations specific to risk assessment are presented below.

Pollution Prevention Advisory Council Recommendation 28:

DEHNR should establish a working group to review and approve consistent risk assessment protocols and to evaluate the acceptability of proposed alternative protocols.

28a. The risk assessment protocols should be multimedia, address various types of risks, and be applied as consistently as possible by DEHNR.

28b. The working group should develop guidance documents describing the established risk assessment protocols. Guidance documents can be used to ensure adherence to the protocols.

28c. The working group should consider the applicability of EPA guidance and incorporate it, as appropriate.

28d. DEHNR should provide a mechanism for public participation in the development of the guidance.

A departmental working group ("the Risk-Based Protocol Working Group or the Working Group") was formed in June 1995 to fulfill the PPAC recommendation. Members were recruited from divisions within the Department involved in protection of human health and the environment, and regulation of locations where groundwater or soil may have been adversely affected by environmental contamination.

North Carolina's General Assembly recognized the potential benefits of using risk assessment at contaminated sites within North Carolina, when in 1995, it modified laws covering petroleum underground storage tanks. The changes require that the Environmental Management Commission adopt rules incorporating risk assessment and risk management into the regulation of petroleum underground storage tank sites. As a result, the Department has looked toward the Working Group to develop a risk-based approach to satisfy this legislation as well as the PPAC recommendation.

B. Mission Statement

The mission of the Risk-Based Protocol Working Group is to develop risk analysis procedures in the form of a protocol document for the Department that will be used to:

- Evaluate the risk of harm to human health, the environment, and public welfare;
- Complement existing risk assessment methods; and
- Support decisions concerning the need for, method of, and extent of risk reduction.

The efforts of the Working Group have resulted in the development of this risk analysis framework.

C. Purpose

The Risk Analysis Framework describes scientific procedures for determining contaminant target concentrations (concentration of the contaminant at which no further clean-up is required based upon the risk of harm posed by the contaminant) and assessing the risk of harm to human health, the environment and public welfare. These procedures promote consistent decision making for locations regulated by the Department where groundwater or soil may have been adversely affected by environmental contamination. As such, it is intended that this document be used as a framework for regulatory programs to determine acceptable target concentrations, conduct site-specific risk assessments and select risk management strategies.

Information obtained by following the procedures will be used in determining the need for and extent of corrective action or other management strategies to protect human health and the environment. Application of the document in specific cases may be limited by federal regulatory requirements and North Carolina General Statutes.

D. Applicability

This document is applicable to all North Carolina locations regulated by the Department where groundwater or soil may have been adversely affected. These locations include, but are not limited to inactive hazardous sites, hazardous waste sites, active and inactive municipal solid waste sites, leaking underground storage tanks, and spill sites. The document is intended to provide cost-effective and risk-based assessment of the need for and extent of clean-up of contamination.

This document can be used to evaluate the risks at contaminated sites and to assist in making decisions about clean-up by answering such questions as:

- Is clean-up necessary?
- What level of clean-up is needed, as measured by the concentrations of chemicals that can safely remain at the site without jeopardizing human health, the environment and public safety?

The responsible party and the responsible regulatory programs can answer these questions and make appropriate decisions based on target concentrations or using site-specific risk assessments discussed in this document.

This document presents a streamlined tiered (Methods I, II and III) approach for evaluating risk, one that has the potential to be more cost-effective and flexible for the responsible parties and the Department than traditional methods. Additionally, the streamlined, tiered approach will serve to lessen confusion on the part of the responsible parties and consultants who work with the Division of Water Quality and the Division of Waste Management. The option of conducting a site-specific risk assessment, if conditions at the site warrant one and the regulatory program concurs, is also presented in this document.

The responsible party should fully review this document and the target concentrations applicable to their site to determine the most cost-effective and environmentally protective actions. Any final decisions made in response to contamination must be approved by the appropriate DEHNR regulatory program. Use of this Framework at federally-regulated sites is at the discretion of the federal government.

E. Risk Analysis in the Regulatory Process

In order to protect the environment of the State and the health of its citizens, discharges of contaminants must be contained or cleaned up. Discovery of a discharge or release "triggers" the regulatory process in which the responsible party must initiate certain response actions to comply with the statutes and rules of the State.

These response actions are listed and discussed below in the order that they are generally performed and are outlined in Figure 1.1:

- Emergency response;
- Initial site investigation;
- Site assessment;
- Risk analysis;
- Clean-up actions;
- Compliance monitoring; and
- Site closure.

All DEHNR programs responsible for oversight of contaminated sites follow this general process.

Risk analysis, as described in this document, should be performed only after sufficient information concerning the nature and extent of the contamination has been collected. Generally, sufficient information to conduct a risk analysis is collected during the site assessment phase. Therefore, a risk analysis should be performed after completion of a site assessment.

The results of the risk analysis may be submitted to the Department with the results of the site assessment or with a plan for clean-up of the contamination. If no clean-up is required, then the risk analysis results may be submitted to the Department along with a petition for site closure (in accordance with the rules of the appropriate regulatory program). Chapter 4 lists the documentation that should be submitted to the Department along with the risk analysis results.

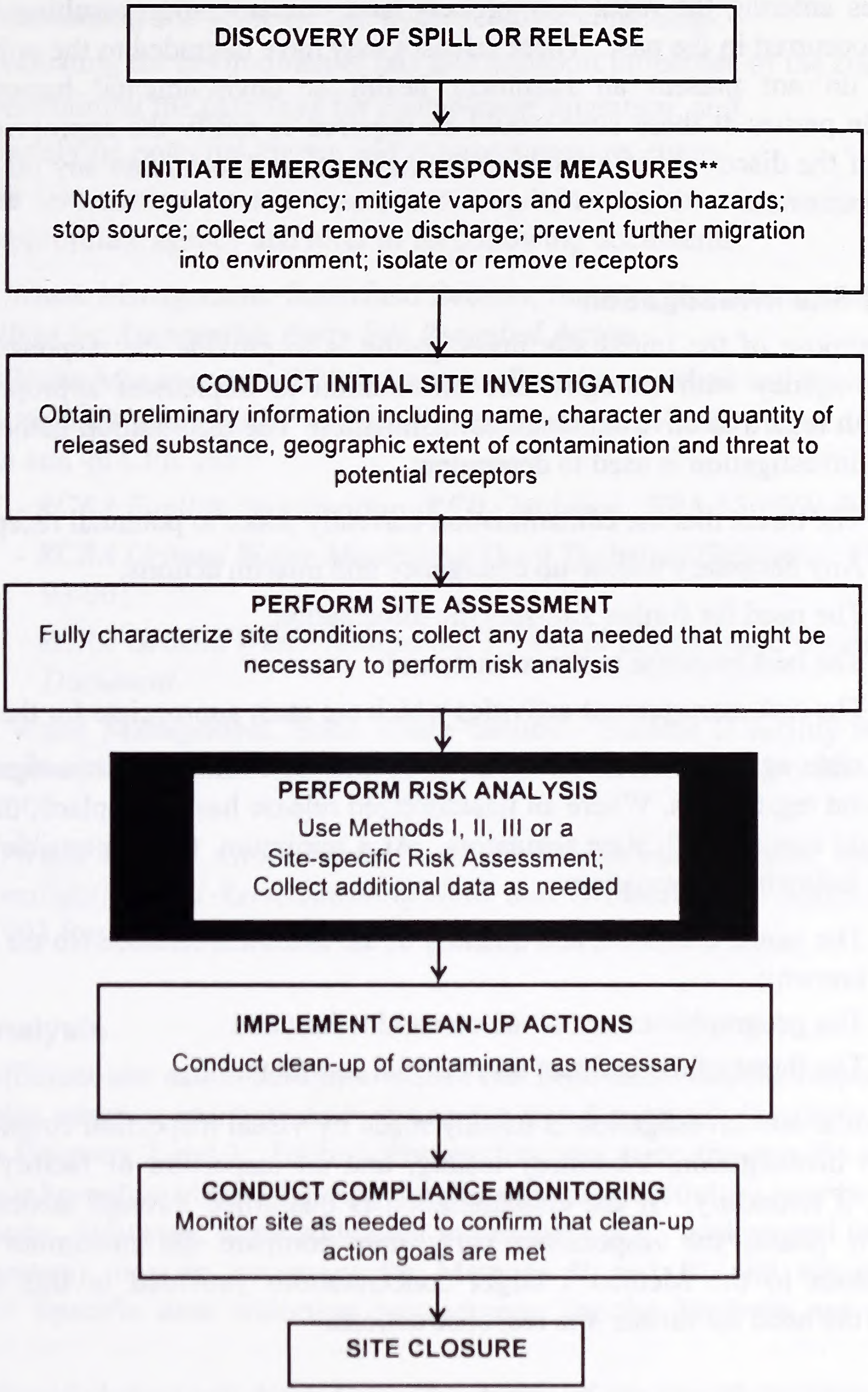
Emergency Response

Emergency response is a system set in place by General Statute (primary statute is North Carolina General Statute 166A), Executive Orders (primary executive orders are Executive Orders 16 and 17), and North Carolina Administrative Code (15A NCAC 2L, the groundwater protection rules, and 15A NCAC 2N, the underground storage tank rules) which requires the initial threat posed by discharges to be mitigated or controlled.

A number of industrial facilities that handle hazardous chemicals or hazardous wastes operate under emergency or contingency plans as directed by applicable federal, state or local laws. Activation of such a plan and the subsequent emergency actions and follow-up also constitute an emergency response.

Emergency response typically occurs prior to site assessment activities or risk analysis and has two elements, notification and mitigation/control. When an incident involving environmental contamination has taken place, it is essential that the appropriate agencies are promptly notified and control efforts are begun. Concurrent with the notification process, an effort to mitigate fire, explosion, and vapor hazards must take place in order to protect human health and the environment. Effective mitigation/control

Figure 1.1. Risk Analysis in the Regulatory Process*



DISCOVERY OF SPILL OR RELEASE

INITIATE EMERGENCY RESPONSE MEASURES**
Notify regulatory agency; mitigate vapors and explosion hazards; stop source; collect and remove discharge; prevent further migration into environment; isolate or remove receptors

CONDUCT INITIAL SITE INVESTIGATION
Obtain preliminary information including name, character and quantity of released substance, geographic extent of contamination and threat to potential receptors

PERFORM SITE ASSESSMENT
Fully characterize site conditions; collect any data needed that might be necessary to perform risk analysis

PERFORM RISK ANALYSIS
Use Methods I, II, III or a Site-specific Risk Assessment; Collect additional data as needed

IMPLEMENT CLEAN-UP ACTIONS
Conduct clean-up of contaminant, as necessary

CONDUCT COMPLIANCE MONITORING
Monitor site as needed to confirm that clean-up action goals are met

SITE CLOSURE

* Detailed requirements and scope of the various steps in this process remain the responsibility of the lead regulatory program for each site. The diagram is presented to demonstrate the role that Risk Analysis can play in the overall management of contaminated sites.

** For sites with contamination that does not represent an imminent health hazard or where there is no flow of product into the environment, the responsible party may not be required to initiate emergency response measures other than notification.

efforts, in addition to protecting human health and the environment, may also avert or reduce the scale of a time consuming and costly environmental clean-up.

It should be noted that emergency response measures are not required at all sites. Many sites entering the regulatory process have contamination resulting from releases that have occurred in the past. These releases may have degraded to the point where they currently do not present an imminent health or environmental hazard. Therefore, responsible parties at these sites would be required to notify the appropriate regulatory program of the discovery of a release, but may not need to initiate any other emergency response measures.

Initial Site Investigation

The purpose of the initial site investigation is to provide the responsible party and regulatory agency with enough basic information to implement appropriate response actions with regard to environmental contamination. The information gathered during an initial site investigation is used to determine:

- The threat that the contamination currently poses to potential receptors;
- Any necessary follow-up emergency and interim actions;
- The need for further site-specific information;
- The best response to the release; and
- The risk management activities which are most appropriate for the site.

Some state agencies define their requirements for conducting investigations in their guidance and regulations. Where an unauthorized release has taken place, the responsible party should consult with state regulators. At a minimum, the responsible party should obtain the following information:

- The name, character, and quantity of the materials released (to the extent known);
- The geographic extent of the contamination; and
- The threat of the incident on potential receptors.

The initial site investigation is usually made by visual inspection coupled with basic subsurface investigation, laboratory testing, and an inspection of facility records and manifests, if necessary. If the contamination is quantified through laboratory analysis during this phase, the responsible party may compare the maximum contaminant concentrations to the Method I target concentrations provided in this document, to determine the need for further site response actions.

Site Assessment

Each regulatory program within the Department has its own requirements for site assessment. However, the primary goal for all programs is to obtain sufficient information to be able to make decisions concerning the need for and extent of clean-up actions.

In general, site assessment activities include:

- Identifying the source(s) of contamination;
- Characterizing the nature and extent of the contamination;
- Determining site geologic and hydrogeologic conditions;
- Evaluating the environmental fate and transport properties of the contaminants;
- Determining the pathways for contaminant migration; and
- Identifying potential human and environmental receptors.

For more information on site assessment requirements, the responsible party may contact the appropriate agency and refer to the following documents:

Division of Waste Management, Superfund Section, Inactive Hazardous Sites Program - *Guidelines for Responsible Party Site Remedial Action.*

Division of Waste Management, RCRA Section - Requires vertical and horizontal extent of contaminant plume to be verified for each unit at a facility in accordance with SW846 and 40 CFR 265.

- *RCRA Facility Investigation (RFI) Guidance.* EPA 530/SW-89-031.
- *RCRA Ground Water Monitoring Draft Technical Guidance.* EPA 530-R-93-001.
- *RCRA Ground Water Monitoring Technical Enforcement Guidance Document.*

Division of Waste Management, Solid Waste Section - Subtitle D facility requirements for site assessment and corrective action must be in accordance with 15A NCAC 13B .1600.

Division of Water Quality, Groundwater Section - *Groundwater Section Guidelines for the Investigation and Remediation of Soils and Groundwater.* March 1993 (with June 1993 Revisions incorporated).

Risk Analysis

Once sufficient site assessment information has been collected, the responsible party may determine target concentrations by using the tiered approach (Methods I, II or III) presented in Chapters 2 and 3. Each successive tier uses more site-specific information. Much of the information obtained during the site assessment activities may be used for all of the Methods. However, some additional information (e.g., background levels, model input parameters) may be necessary for Methods II and III and site-specific risk assessment. Specific data collection requirements for the Methods are provided in Chapter 4.

The choice of method will depend upon the degree of site specificity desired. Method I involves the use of default target concentrations provided by the Department. These target concentrations are based on conservative assumptions. For Method II, the responsible party calculates target concentrations using some site-specific data. Method

III allows the responsible party to use a more complex transport model for calculating target concentrations at sites within the G-2, G-3 or S-3 categories.

Responsible parties have the option of conducting a site-specific risk assessment with the approval of the appropriate regulatory program. There are some instances where a site-specific risk assessment may be required by the regulatory program responsible for overseeing a site. For example, a site-specific risk assessment may be required to address critical exposure situations or when multiple contaminants and multiple exposures exist.

A site-specific risk assessment involves estimating and quantifying the total risk posed by contamination at a site. If the maximum contaminant concentrations at a site are less than or equal to the target concentrations in Methods I, II or III, or if the total risk calculated using a site-specific risk assessment is less than or equal to the acceptable level of risk, the site may be considered to pose no significant risk. However, if the maximum concentrations exceed the target concentrations or the total risk exceeds the acceptable level of risk, the site is considered to pose an unacceptable risk and action must be taken by the responsible party to reduce the risk to acceptable levels.

Clean-up Actions

North Carolina has several sources of authority for requiring clean-up action and other response actions at sites with environmental contamination. The State is authorized to implement its RCRA program pursuant to federal regulation in 40 CFR 264 and to address releases related to Subtitle D landfills in accordance with 15A NCAC 13B.1600. Releases of oil and hazardous substances are also regulated under North Carolina General Statute 143-215, which authorizes the Division of Water Quality to promulgate and enforce its environmental rules. The Inactive Hazardous Sites Program was created to address sites contaminated with hazardous substances that are not being cleaned up by other environmental programs. The Inactive Hazardous Sites Program derives its authority from the Inactive Hazardous Sites Response Act of 1987 (N.C. G. S. 130A-310 et. seq.)

Clean-up actions typically consist of removal or treatment of the contaminated media. Other response actions may be taken to control exposure to contamination. These control actions include preventing the migration of contamination by pumping groundwater to maintain hydraulic control or using an engineered barrier. Control actions may also include measures (e.g., fences, warning signs) limiting access to a site to minimize exposure (contact of an organism with a chemical or physical agent) to the contamination. Clean-up or control actions may be taken during and following site assessment while comprehensive site response actions are being determined. If such actions are completed prior to implementation of a comprehensive site clean-up, these actions are termed interim measures.

Compliance Monitoring

Following a comprehensive site clean-up, compliance monitoring is required to confirm that clean-up or other management strategy goals are satisfied. Under the risk assessment framework, a period of monitoring may be required prior to closure to demonstrate that existing site conditions persist or improve with time and to validate modeling predictions and assumptions. Actions taken regarding compliance monitoring results will be determined by the regulatory program responsible for the site.

Site Closure

The last step in the regulatory process is site closure. Closure refers to the management step where further investigation and clean-up at a site are ended and the regulatory oversight requirements are greatly reduced or eliminated. A number of technical and regulatory steps are required to "close" a site. These requirements vary with the environmental rules and regulations to which the site or facility is subject and with the amount and nature of the contaminants present at that site. However, the goals are the same: to achieve a closure which requires no further action by the regulatory agency and the responsible party.

Facilities that are regulated under RCRA may be required to go through a special closure process before being cleaned up to health protective levels. This process is referred to as “post-closure.” Typically, these sites cannot be cleaned up for technical or economic reasons and the owner/operator is still potentially liable for any adverse impacts. Such closures must also include an impermeable cap that is designed to prevent the migration of source contamination. Seeking this option requires long-term (30-year) monitoring, maintenance of control measures, financial assurance requirements, potential deed restrictions, and public notice.

Under the risk analysis framework, it is possible to achieve site closure, if it is determined that the contamination at a site poses no significant risk to human health or the environment given the assumptions made concerning current and future receptors and use of the site. However, to close sites with contamination remaining at levels above the G-1 (current or potential drinking/non-drinking water exposures) target concentrations for groundwater or S-1 (residential) target concentrations for soil, it will be necessary to use some form(s) of institutional control to ensure that the assumptions concerning current and future receptors and uses of the site remain the same. Use of institutional controls will also serve to provide notification of the environmental status of a property to prospective property owners, tenants and the general public.

Institutional controls generally include the following measures:

- deed restrictions,
- restrictive covenants,
- use restrictions,
- notice (record notice, actual notice or notice to government agencies),
- Registry Act requirements, and
- Property Transfer Act requirements.

F. Document Organization

Chapters 2, 3 and 4 of this document present the procedures for conducting risk analysis at contaminated sites.

Chapter 2 provides an overview of the groundwater and soil exposure categories and the methods for determining target concentrations and conducting a site-specific risk assessment.

Chapter 3 describes detailed procedures for using the methods. Worksheets to be used with the procedures in Chapter 3 are provided in **Appendix 1**.

Chapter 4 describes the site data collection requirements necessary to determine the applicable groundwater and soil categories and to use the methods. Documentation that should be submitted to the Department along with the risk analysis results is also listed in Chapter 4.

Chapter 5 contains the references for Chapters 1 through 4.

Appendix 2 presents information on assumptions and default values used by the department for Methods I and II.

Appendix 3 contains toxicity and risk assessment references to be used with Method II, Method III and site-specific risk assessments.

Appendices 4, 5 and 6 provide the criteria used by the Department to calculate the Method I target concentrations for the G-1, G-2 and G-3 groundwater categories, respectively. Appendix 6 also describes the methodology used in calculating Method I and II G-3 target concentrations.

Appendices 7, 8 and 9 provide the criteria used by the Department to calculate the Method I target concentrations for the S-1, S-2, and S-3 soil categories, respectively.

Appendix 10 presents guidance for performing and documenting groundwater modeling.

Appendix 11 describes the site data collection requirements.

CHAPTER 2 - OVERVIEW OF METHODS

A. General Description of Methods

The Department has established three approaches (Methods I, II and III) that may be used to determine target concentrations for groundwater and soil. Figure 2.1 illustrates the risk analysis process. Method I involves the use of "look-up" tables of non-site specific target concentrations that are pre-calculated by DEHNR. These target concentrations are based on conservative assumptions and may be used for all sites in North Carolina.

Under Method II, the responsible party may calculate a target concentration for contaminants not included in the tables in Chapter 3 by using the same equations and assumptions DEHNR used to develop the Method I target concentrations. Method II also allows the responsible party to calculate target concentrations using some site-specific information, such as natural background concentrations and site hydrogeologic data.

In Method III, the responsible party may use more complex modeling to determine target concentrations. Models used in Method III must be approved by the appropriate regulatory program.

Target concentrations determined using Methods I, II and III should be protective of human health and the environment. A responsible party may also choose, with the agreement of the appropriate regulatory program(s), to conduct a site-specific risk assessment to determine the total risk posed by the contamination.

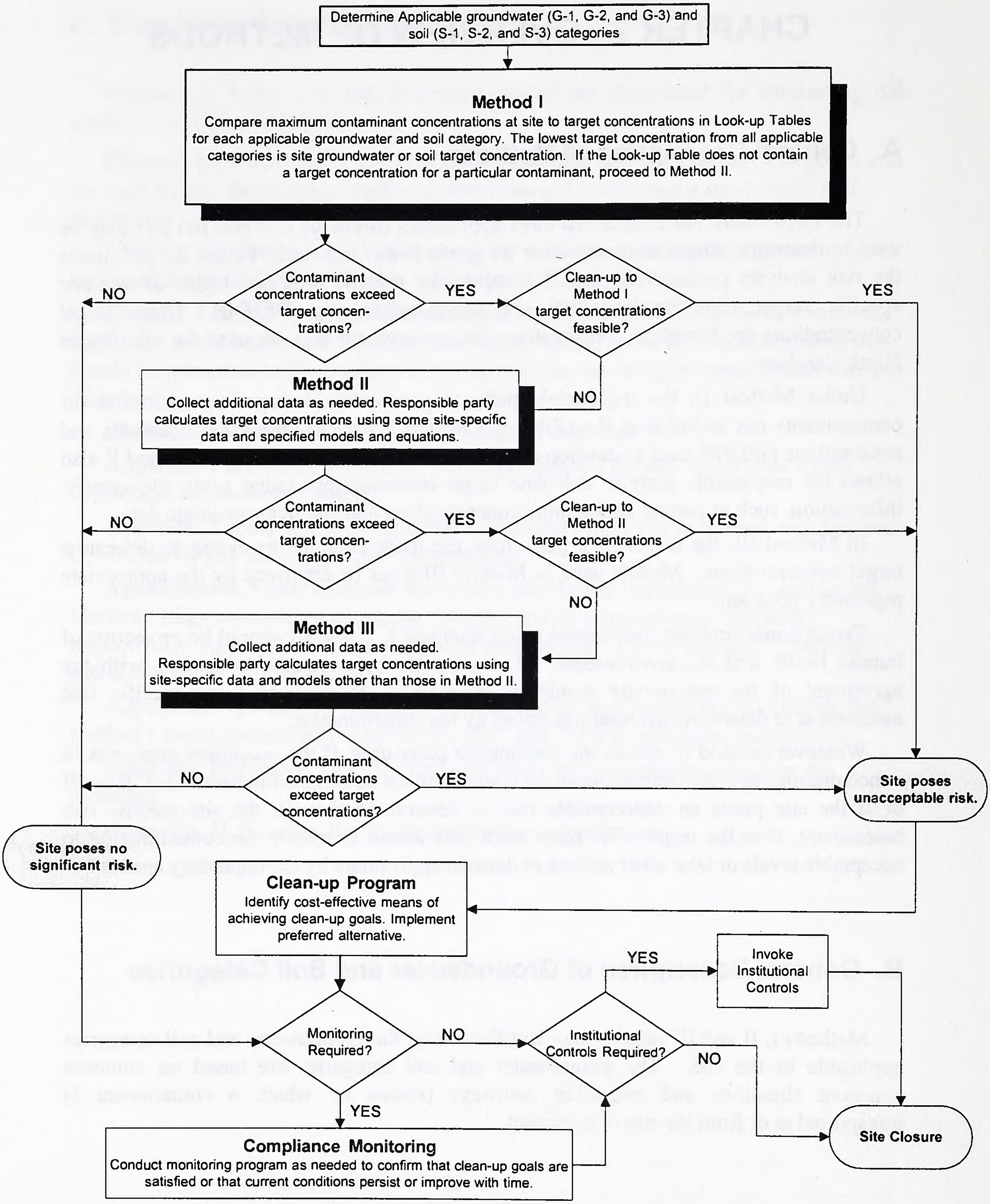
Whatever method or option the responsible party uses, if the maximum contaminant concentrations at a site exceed the target concentrations determined in Methods I, II or III or if the site poses an unacceptable risk as determined through the site-specific risk assessment, then the responsible party must take action to reduce the contamination to acceptable levels or take other actions as deemed appropriate by the regulatory agency.

B. General Description of Groundwater and Soil Categories

Methods I, II and III require the identification of the groundwater and soil categories applicable to the site. The groundwater and soil categories are based on common exposure situations and migration pathways (routes by which a contaminant is transported at or from the site of a release).

Figure 2.1

Risk Analysis Process*


Determine Applicable groundwater (G-1, G-2, and G-3) and soil (S-1, S-2, and S-3) categories
Method I
Compare maximum contaminant concentrations at site to target concentrations in Look-up Tables for each applicable groundwater and soil category. The lowest target concentration from all applicable categories is site groundwater or soil target concentration. If the Look-up Table does not contain a target concentration for a particular contaminant, proceed to Method II.
Contaminant concentrations exceed target concentrations?
NO
YES
Clean-up to Method I target concentrations feasible?
YES
NO
Method II
Collect additional data as needed. Responsible party calculates target concentrations using some site-specific data and specified models and equations.
Contaminant concentrations exceed target concentrations?
NO
YES
Clean-up to Method II target concentrations feasible?
YES
NO
Method III
Collect additional data as needed.
Responsible party calculates target concentrations using site-specific data and models other than those in Method II.
Contaminant concentrations exceed target concentrations?
NO
YES
Site poses unacceptable risk.
Site poses no significant risk.
Clean-up Program
Identify cost-effective means of achieving clean-up goals. Implement preferred alternative.
Monitoring Required?
NO
YES
Institutional Controls Required?
YES
NO
Invoke Institutional Controls
Site Closure
Compliance Monitoring
Conduct monitoring program as needed to confirm that clean-up goals are satisfied or that current conditions persist or improve with time.

* If appropriate and with the approval of the lead regulatory program, the responsible party may conduct a site-specific risk assessment to determine the total risk posed by the contamination.

Groundwater Categories

The Department has grouped contaminated groundwater in North Carolina into the following three groundwater categories:

Category G-1: Current or potential drinking water (this category also includes current or potential non-drinking water exposures such as from swimming pools or irrigation).

Category G-2: Current or potential exposure to groundwater contaminants via movement of vapor from groundwater through soil to a nearby building (or other indoor air space such as an elevator shaft or crawl space). To be included in this category, contaminated groundwater must be:

A. At a vertical depth of 15 feet or less from the soil surface or building substructures; and

B. Within 30 horizontal feet of either an existing building or a preferred pathway (e.g., sewer pipes, water mains) to the building.

Category G-3: Current or potential movement of ground-water contaminants into surface water.

All groundwater categories that apply to a site are to be identified and used in determining the target concentrations. At some sites, more than one category may apply. If multiple categories apply, then the lowest target concentration will be the required groundwater target concentration. If none of the groundwater categories apply, the maximum contaminant concentrations at a site must not exceed the ceiling concentration limits described in Section C of this chapter. For a site at which G-1 target concentrations are not applicable but are exceeded, land use restrictions and other forms of institutional controls may apply.

Soil Categories

The Department has grouped contaminated soil in North Carolina into the following three soil categories:

Category S-1: Residential, recreational, day-care, or other equally sensitive exposure situations.

Category S-2: Industrial or commercial exposure situations.

Category S-3: Current or potential movement of soil contaminants to groundwater. This category is further subdivided into these categories:

S-3: G1 - Movement of contaminants from soil to groundwater used as drinking water or for non-drinking water activities such as irrigation or filling swimming pools;

S-3: G2 - Movement of contaminants from soil to groundwater that may vaporize into indoor air space(s); and

S-3: G3 - Movement of contaminants from soil to groundwater that may interact with surface water.

All soil categories that apply to a site are identified and used in determining the target concentrations. The contaminated soil at all sites is assumed to have the potential to affect groundwater. Therefore, responsible parties must determine a target concentration for the S-3 category. The lowest target concentration from all applicable categories will be the required soil target concentration. Land use restrictions and other forms of institutional controls may apply to sites at which S-1 target concentrations are not applicable but are exceeded.

C. Ceiling Concentration Limits

Ceiling concentration limits (CCLs) are to be used at sites where none of the groundwater categories apply. They are also used in determining the G-2 and G-3 target concentrations.

The CCL for each contaminant is the lower of :

- 1000 times the groundwater quality standard or the interim standard established per 15A NCAC 2L .0202; or
- 50 percent (%) of the aqueous solubility of the compound.

The maximum contaminant levels in groundwater at these sites must not exceed the CCLs. The presence of non-aqueous phase liquids in groundwater shall be considered a level that exceeds the CCL.

To address cumulative and long range adverse impacts on the environment, CCLs were set by the Department to minimize gross degradation of the State's groundwater resources.

D. Other Exposure Categories

In addition to the exposure situations identified for groundwater and soil, other human and ecological exposures may need to be evaluated (e.g., ingestion of fish and protection of sensitive species and environments). During the site data collection, all potential receptors must be identified. At sites where ecological receptors such as wetlands and endangered plant or animal species are present, additional assessment may be warranted to determine if the target concentrations for the sites are sufficient to protect the receptors.

The soil and groundwater categories in Methods I, II and III were chosen to protect surface water and groundwater standards and will be sufficient to protect a majority of the ecological receptors; however, where endangered species are present, the regulatory program that has authority over the site must be consulted. Additional data collection and analysis may be necessary for these sites. The risk to sensitive species or habitats posed by the remediation may need to be considered.

In the case of areas with special geological or hydrological characteristics (e.g., complex rock fractures, multiple aquifer impacts or complex ecosystems), additional modeling may be needed to ensure that assumptions made within the equations and models apply.

E. Choosing A Method

Once the applicable groundwater and soil categories are identified, the responsible party can use Method I target concentrations provided by the Department or may calculate a target concentration using Method II or III. Tables 2.1 and 2.2 outline the procedures for Methods I, II and III determinations of target concentrations for groundwater and soil, respectively. Method III applies only to the G-2, G-3 and S-3 categories. If the responsible party wishes to use a site-specific risk assessment, then the appropriate agency within the Department must be consulted to determine if a site-specific risk assessment is applicable and to discuss current risk assessment methodologies.

Each successive method uses more site-specific information to determine target concentrations for groundwater and soil. The choice of method or option will depend upon the degree of site-specificity desired. The responsible party must balance the cost of the additional data gathering and analysis required for Method II, Method III or a site-specific risk assessment with the potential benefit of deriving a higher acceptable soil or groundwater target concentration than the conservative Method I target concentration. There are also potential land use restrictions and other institutional controls to be considered.

Table 2.1. Target Concentration Determination and Land Use Restriction Potential for Methods I, II and III by Groundwater Category

CATEGORY		METHOD I	METHOD II	METHOD III
G-1 Current or potential drinking water (also includes non-drinking water exposures)	Target Concentration Determination	Table with non-site specific target concentrations based on groundwater quality standards or interim maximum allowable concentrations (Chapter 3 Table 3.1).	Responsible party calculates target concentrations based on groundwater quality standards or interim maximum allowable concentrations and site-specific groundwater background levels.	Not Applicable
	Restrictions	No	No	Not Applicable
G-2 Groundwater to Indoor Air	Target Concentration Determination	Table with non-site specific target concentrations based on health protective level for indoor air (Chapter 3 Table 3.1).	Responsible party calculates target concentrations protective of indoor air using site-specific groundwater background levels and a vapor transport model.	Same as Method II except that the responsible party chooses vapor transport model.
	Restrictions	Yes, no drinking/non-drinking water uses per G-1 definition.		
G-3 Groundwater to Surface Water	Target Concentration Determination	Table with non-site specific target concentrations based on protection of health and environmentally protective levels in surface water (Chapter 3 Table 3.2).	Responsible party calculates target concentrations protective of surface water using site-specific groundwater background levels and a groundwater transport model incorporating site-specific parameters.	Same as Method II except that the responsible party chooses the groundwater transport model.
	Restrictions	Yes, no drinking/non-drinking water uses per G-1 definition.		
		Target concentration is the lowest level from all applicable categories.		

Table 2.2. Target Concentration Determination and Land Use Restriction Potential for Methods I, II and III by Soil Category

CATEGORY		METHOD I	METHOD II	METHOD III
S-1 Residential areas (includes recreational, day care or other equally sensitive exposure situations)	Target Concentration Determination	Table with non-site specific target concentrations based on residential exposure through ingestion (Chapter 3 Table 3.3).	Responsible party calculates target concentrations using equations and site-specific soil background levels.	Not Applicable
	Restrictions	No		Not Applicable
S-2 Industrial or Commercial Areas	Target Concentration Determination	Table with non-site specific target concentrations based on industrial/commercial exposure through ingestion (Chapter 3 Table 3.3).	Responsible party calculates target concentrations using equations and site-specific soil background levels.	Not Applicable
	Restrictions	Yes, no residential uses per S-1 definition.		Not Applicable
S-3 Soil to Groundwater	Target Concentration Determination	Table with non-site specific target concentrations based on potential for soil contaminants to leach into groundwater (Chapter 3 Tables 3.4 and 3.5).	Responsible party calculates target concentrations protective of groundwater using site-specific groundwater background levels and a groundwater transport model incorporating site-specific parameters.	Same as Method II except responsible party chooses groundwater transport model.
	Restrictions	For S-3:G-1 = No restrictions. For S-3:G-2 & S-3:G-3 = Yes, no drinking/non-drinking water uses per G-1 definition.		
		Target concentration is the lowest level from all applicable categories.		

CHAPTER 3 - METHODS

A. Preliminary Guidelines

Three methods (Methods I, II and III) may be used by responsible parties to determine target concentrations in groundwater and soil at locations regulated by the Department. By comparing these target concentrations to the maximum contaminant concentration at a site, the necessity for and extent of clean-up can be determined. Alternatively, a responsible party may decide or may be required to use a site-specific risk assessment to determine cumulative risk at a site. If a site-specific risk assessment is chosen, then the Department must be consulted prior to beginning the assessment. Under some programs, a site-specific risk assessment may be required to address critical exposure situations not covered by the methods or sites with multiple contaminants and multiple exposures.

The Department requires the responsible party to take appropriate clean-up action at a site if concentrations in groundwater or soil exceed the target concentrations determined using the three methods, or if the site poses an unacceptable risk as determined from the site-specific risk assessment.

The procedures for determining Methods I, II and III target concentrations are presented in this chapter. Method I target concentrations for groundwater and soil are listed in Tables 3.1, 3.2, 3.3, 3.4 and 3.5, located at the end of this chapter. Method II target concentrations are calculated by the responsible party using the flow charts, procedures, worksheets and equations provided. Method III target concentrations may be calculated by the responsible party for categories G-2, G-3 and S-3, using another transport model. For category G-3, Method III must be used if the groundwater plume is located in fractured bedrock or if the groundwater saturated thickness above bedrock is less than 15 feet (distance between the top of the bedrock and the groundwater table is less than 15 feet).

Worksheets to be used to determine Methods I, II and III groundwater and soil target concentrations are located in Appendix 1. *The responsible party must complete the worksheets in Appendix 1 and submit them to the appropriate regulatory program.* Defaults and assumptions used to calculate target concentrations are described in Appendix 2. Additional references are listed in Appendix 3.

The site-specific risk assessment option is also discussed in this chapter. Due to the comprehensive nature of a site-specific risk assessment, only general guidance is presented. Additional guidance can be found in the references cited in Section G of this chapter and Appendix 3.

Prior to using Methods I, II, or III or conducting a site-specific risk assessment, the responsible party should review Chapter 4, "Data Collection Requirements." During the site assessment, all potential receptors must be identified. At sites where ecological receptors such as wetlands and endangered plant or animal species or habitats are present, additional assessment may be warranted to determine if target concentrations at the sites are sufficient to protect all receptors. General guidelines for ecological assessment are in Section H of this chapter and should be considered for all sites.

B. Determination of Applicable Groundwater and Soil Categories

The Department has grouped groundwater and soil into categories representing common exposure situations. The three groundwater categories (G-1, G-2 and G-3) and three soil categories (S-1, S-2, and S-3) are defined below. The category definitions that follow this paragraph are to be used by the responsible party in conjunction with the Worksheets in Appendix 1 to determine the categories present at the site. Target concentrations are determined for each category that applies to a site. At sites where more than one category applies, the lowest target concentration is adopted. Land use restrictions and other forms of institutional controls may apply at sites where groundwater and soil contaminant concentrations remain at levels greater than G-1 target concentrations or S-1 target concentrations, respectively.

It may be possible for a responsible party to provide evidence documenting a situation in which none of the exposure categories apply to groundwater at a particular site. This documentation must be submitted to the appropriate regulatory agency. If the evidence is sufficient to prove that none of the groundwater categories apply at the site, a Ceiling Concentration Limit (Section F of this chapter) will apply.

Groundwater Category Definitions

Category G-1 (drinking and non-drinking water exposure)

Groundwater is or may be used by the citizens of the state as a drinking water source or for other uses which may result in ingestion. Groundwater is considered to be in the G-1 category if:

- Groundwater is or may be used as a source for private or public water supply;
- Groundwater has been used as a public water supply in the past and may reasonably be expected to be used as such again in the future;
- Groundwater may reasonably be expected to be used as a public water supply, if needed, in the future; or
- Groundwater is or may be used for purposes other than drinking (e.g., swimming pools, irrigation, washing cars) where humans may be exposed to contamination.

The following locations are excluded from Category G-1:

- Locations where water supplies are provided by a public water supply system to all properties potentially affected by contamination and the public water supply system obtains its water from surface water, or from groundwater that is hydraulically isolated from contaminated aquifers;
- Locations where a Water Supply Plan has been completed and approved in accordance with 15A NCAC 18C .0300 and the Water Supply Plan does not plan for the use of groundwater for drinking within a 30-year planning period and the Water Supply Plan establishes provisions to provide public water supplies to all residents; or
- Locations where local ordinances prohibit installation of private water supply wells and water supplies are provided by a public water supply system that obtains its water from surface water or from groundwater that is hydraulically isolated from contaminated aquifers.

Category G-2 (movement of contaminant from groundwater to indoor air)

This category applies to sites where there is current or potential contaminant movement from groundwater into indoor air. Contaminants in groundwater may evaporate and move in vapor form from groundwater through soil to a nearby building (or other indoor air space such as an elevator shaft or crawl space). For a site to be in this category, contaminated groundwater must be:

- At a vertical depth of 15 feet or less from the soil surface or building substructures, and
- Within 30 horizontal feet of either an existing building or a preferred pathway (e.g., sewer pipes, water mains) to the building.

Category G-3 (movement of contaminant from groundwater to surface water)

Category G-3 applies to sites where there is current or potential movement of groundwater contaminants to surface water. All groundwater is assumed to have the potential to impact surface water unless documentation to the contrary is provided and the regulatory program concurs.

Soil Category Definitions

Category S-1 (residential exposure to soil contaminants)

Category S-1 includes sites that are in current or potential residential areas or are used for activities of sensitive human receptor populations or where extended exposure may occur (e.g., schools, day-care facilities and retirement centers). The soil target concentrations developed for these sites are based on residential child and adult ingestion exposures. The S-1 soil target concentrations must be met throughout the entire soil column. Institutional controls do not specifically apply to this category. However, institutional controls may still apply to sites that meet residential target concentrations (S-1) and where groundwater contaminant concentrations remain at levels greater than G-1 target concentrations.

Category S-2 (industrial/commercial exposures to soil contaminants)

Category S-2 includes sites where human exposure is due to work-related activities and is based on adult exposure to contaminants. Since these activities do not require most people to be on-site for more than 8-10 hours per day, exposure frequency and soil ingestion rate are less than for category S-1. Institutional controls may be necessary at sites meeting S-2 target concentrations to preclude residential exposures.

Category S-3 (movement of contaminant from soil to groundwater)

The S-3 category applies to contaminants in soil that have the potential to impact groundwater. All contaminated soil is considered to have the potential to impact groundwater in the absence of documentation to the contrary. S-3 concentrations protect groundwater from exceedance of the target groundwater concentrations. There are three S-3 subcategories, one corresponding to each groundwater category:

S-3:G-1 applies to soil at sites where contaminants potentially impact groundwater used for drinking water or non-drinking water exposures such as swimming pools or irrigation.

S-3:G-2 applies to soil at sites where contaminants potentially impact indoor air by migration from the soil to groundwater to indoor air.

S-3:G-3 applies to soil at sites where the contaminants potentially impact groundwater which migrates to surface water.

More than one soil subcategory may apply to a given site.

C. Method I Target Concentration Determination

Method I Groundwater Target Concentrations

Method I target concentrations for all groundwater exposure categories are listed in Tables 3.1 and 3.2 (located at end of this chapter). If a contaminant is not listed in the tables or the detected concentration of a contaminant is above the target concentration listed in the tables, then the responsible party may use one of the other methods to determine target concentrations or conduct a site-specific risk assessment. For Method I target concentrations, groundwater background concentrations were assumed to be zero.

Method I Category G-1 Target Concentrations (drinking and non-drinking water exposure)

Method I target concentrations for category G-1 (drinking water and non-drinking water exposures such as swimming pools or irrigation) are listed in Table 3.1. G-1 target concentrations are the groundwater quality standards or interim standards established in 15A NCAC 2L .0202 (Appendix 4). The groundwater standards and interim standards are developed using state and federal guidelines for the protection of human health.

Method I Category G-2 Target Concentrations (movement of contaminant from groundwater to indoor air)

Method I target concentrations for category G-2 are listed in Table 3.1. G-2 target concentrations take into account contaminants which may volatilize into indoor air from the groundwater via transport through soil or a preferential pathway to a nearby building. Contaminants considered under category G-2 are volatile. Volatile contaminants are defined, for the purposes of this document, as contaminants with a Henry's Law constant of greater than 1 x 10^{-5} atm-m^3/mole and a molecular weight of less than 200 g/mole (EPA 1991).

The equations used to calculate the Method I G-2 target concentrations are explained in Method II G-2. These are the same equations and parameters that a responsible party may use to calculate a target concentration for a chemical not found in Table 3.1. The parameters used to develop Method I G-2 target concentrations are shown in Appendix 5.

Method I Category G-3 Target Concentrations (movement of contaminant from groundwater to surface water)

The G-3 category focuses on the transfer of groundwater contaminants to surface water, taking into account chemical concentration, biodegradation, and distance from the groundwater contaminant plume to the surface water body. Surface water quality standards for the protection of human health (based on fish consumption) and aquatic life, as published in 15A NCAC 2B .0200, were used in determining the Method I G-3 target concentrations.

Method I target concentrations for category G-3 are listed in Table 3.2 by distance of the groundwater plume's leading edge from the potentially impacted surface water body. To use the Method I G-3 target concentrations found in Table 3.2, the responsible party must determine if the site meets the following criteria:

- Groundwater plume is not in fractured bedrock;
- Groundwater plume's leading edge (PLE) is greater than or equal to 250 feet from the surface water body;
- Groundwater plume length is less than 100 feet;
- Potentially impacted surface water is not classified as trout waters (Tr) or water supplies (WS-I through WS-V and FWS); and
- Groundwater saturated thickness above bedrock is greater than 15 feet.

If the site does not meet all of the above criteria, then Method II, Method III or the site-specific risk assessment option must be used. If all of the above conditions are met, then the responsible party may use Table 3.2 to determine the Method I G-3 target concentrations. Three distances are shown in the table. To determine which distance applies at a site, the following increments are used:

- Distance from PLE to the surface water body is >=250 and <500 feet, use 250 feet;
- Distance from PLE to the surface water body is >=500 and <1000 feet, use 500 feet; or
- Distance from PLE to the surface water body is >= 1000 feet, use 1000 feet.

The target concentrations found in Table 3.2 were developed by the Department using a computer software package called the G-3 Groundwater Contaminant Transport Model or G3CTM. This software or model calculates the maximum contaminant concentration (Calculated Source Concentration) that may exist in groundwater at the source without presenting a threat to surface water quality standards. The G3CTM considers surface water quality standards, low-flow characteristics (7Q10) of neighboring surface water bodies, the hydrogeological characteristics of the affected aquifer, the distance of contaminant source to the surface water body, and the dimensions of the groundwater plume at the time of assessment.

Appendix 6 provides more details regarding the G3CTM and the procedures and methodology used for calculating the Method I G-3 target concentrations. The steps used for determining Method I G-3 target concentrations are explained in the description of Method II G-3 .

Target concentrations for G-3, regardless of the method used, relate only to the discharge of contaminated groundwater to surface water and are not applicable to direct discharges to surface waters. Direct discharges via pipe or other conveyance require a National Pollutant Discharge Elimination System (NPDES) permit.

Method I Soil Target Concentrations

Method I soil target concentrations are listed in Tables 3.3, 3.4 and 3.5 (located at the end of this chapter). If a contaminant is not listed in the tables or the concentration of the contaminant at the site is above the concentration listed, the responsible party may use Method II or III to derive the target concentration or a site-specific risk assessment to determine the total risk. For Method I target concentrations, soil background concentrations were assumed to be zero.

Method I Category S-1 Target Concentrations (residential soil exposure)

The Method I S-1 soil target concentrations are listed in Table 3.3. The target concentrations for soil category S-1 were derived using standard EPA risk assessment equations for the ingestion of soil in residential exposures. The methodology and equations used to calculate the Method I S-1 target concentrations are explained in the description of Method II S-1. Other criteria used to determine Method I S-1 target concentrations are shown in Appendix 7.

Method I Category S-2 Target Concentrations (industrial/commercial exposure)

The Method I S-2 soil target concentrations are listed in Table 3.3. The target concentrations for soil category S-2 were derived using standard EPA risk assessment equations for the ingestion of soil in industrial/commercial exposures. The methodology and equations used to calculate the Method I S-2 target concentrations are explained in the description of Method II S-2. Other criteria used to determine Method I S-2 target concentrations are shown in Appendix 8.

Method I Category S-3 Target Concentrations (movement of contaminant from soil to groundwater)

There are three subcategories of S-3 target concentrations, one corresponding to each groundwater category (S-3:G-1, S-3:G-2, and S-3:G-3). Concentrations corresponding to each subcategory are listed in Tables 3.4 and 3.5. The target concentrations for the soil category S-3 are based on protection of the underlying groundwater. The methodology and equations used to calculate the Method I S-3 target concentrations are explained in Method II S-3. Other criteria used to determine Method I S-3 target concentrations are shown in Appendix 9.

D. Method II Target Concentration Determination

Method II Groundwater Target Concentrations

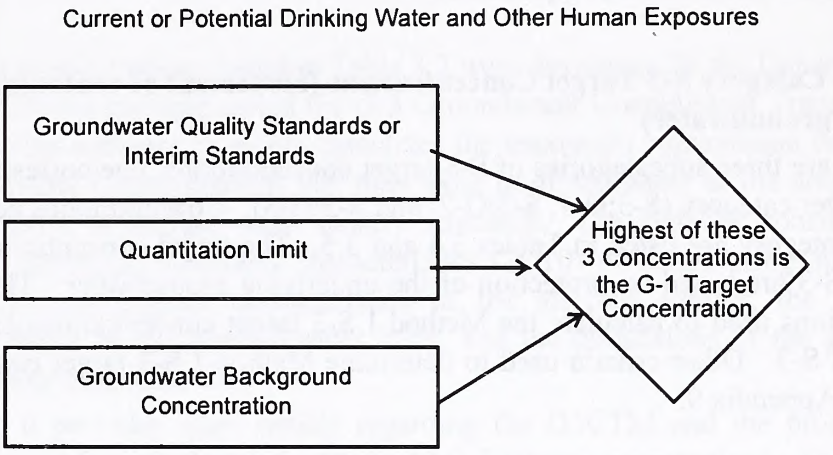
Method II allows the responsible party to derive target concentrations using the same equations and models that the Department used to derive the Method I target concentrations. Some site-specific data may be incorporated into these equations and models.

Method II Category G-1 Target Concentrations (drinking and non-drinking water exposure)

Method II G-1 provides a procedure to calculate target concentrations for compounds not listed in Table 3.1. Target concentrations for Method II G-1 are based on the groundwater quality standard criteria listed in 15A NCAC 2L .0200. If there is not a groundwater quality standard or interim standard, then the responsible party must follow the procedures in 15A NCAC 2L .0202 to obtain an interim standard. This method also allows the use of quantitation limits and naturally occurring groundwater background concentrations to determine Method II G-1 target concentrations. Chapter 4C has more information on determining groundwater background concentrations.

Method II target concentrations for each contaminant are determined using the procedures shown in the following flow chart (Figure 3.1). Quantitation limits (QL) are described in Appendix 2. Documentation of the analytical constraints and development of the QL must be provided to the appropriate regulatory program.

Figure 3.1 Method II Derivation of Target Concentrations for G-1


Current or Potential Drinking Water and Other Human Exposures
Groundwater Quality Standards or Interim Standards
Quantitation Limit
Groundwater Background Concentration
Highest of these 3 Concentrations is the G-1 Target Concentration

* Process for establishing groundwater quality standards or interim groundwater quality standards is listed in 15A NCAC 2L .0202 (c), (d), and (e).

Procedure for Determining Method II G-1 Target Concentrations (drinking and non-drinking water exposure)

For each contaminant use the following steps:

1 Identify applicable groundwater quality standard or interim standard established by 15A NCAC 2L .0202.

2 Use the site-specific, naturally occurring groundwater background level, if available. See Chapter 4C for guidance.

3 Calculate the quantitation limit for the particular analytical method used. See Appendix 2.

4 Take the highest of the three concentrations from steps 1, 2 and 3 as the G-1 Method II target concentration.

Method II Category G-2 Target Concentrations (movement of contaminant from groundwater to indoor air)

Method II G-2 provides a procedure to calculate target concentrations for compounds not listed in Table 3.1. This method also allows the use of naturally occurring groundwater background concentrations and quantitation limits to determine the Method II G-2 target concentration.

G-2 target concentrations are determined only for contaminants for which the Henry's Law constant is greater than 1 x 10^{-5} atm-m^3/mole and the molecular weight is less than 200 g/mole. If these two criteria are not met, then a G-2 target concentration is not required for that contaminant and the next contaminant should be reviewed.

Method II target concentrations for category G-2 are calculated by the responsible party using the transport model in Figure 3.2. All steps and data (including references) used to calculate Method II G-2 target concentrations must be provided. Toxicity values, risk assessment models, and odor recognition thresholds (if available) are used to identify target indoor air concentrations for each contaminant. Appendix 3 provides references for EPA approved toxicity values and risk assessment models.

Figure 3.2. Transport Model for Calculation of G-2 Method II Groundwater Target Concentrations.

$$C_{gw} = \frac{P_{air}}{a \times d \times \left(\frac{H}{R \times T}\right) \times C} = 0.468\left(\frac{P_{air}}{H}\right)$$

	Parameters	Default Values	Units
C_{gw}	Groundwater concentration	chemical-specific	mg/L
P_{air}	Target indoor air concentration†	chemical-specific	mg/m^3
a	Attenuation factor	0.0005	unitless
d	Modification factor	0.1	unitless
H	Henry's law constant	chemical-specific	atm-m^3/mole
R	Gas constant	8.205 x 10^{-5}	atm-m^3/°K-mole
T	Temperature	285	°K
C	Conversion factor	1000	L/m^3

† P_{air} is the lowest of the Air_c, Air_{nc} and 50% Odor Threshold. Air_c and Air_{nc} are calculated per Figure 3.4, Equations 1 and 2.

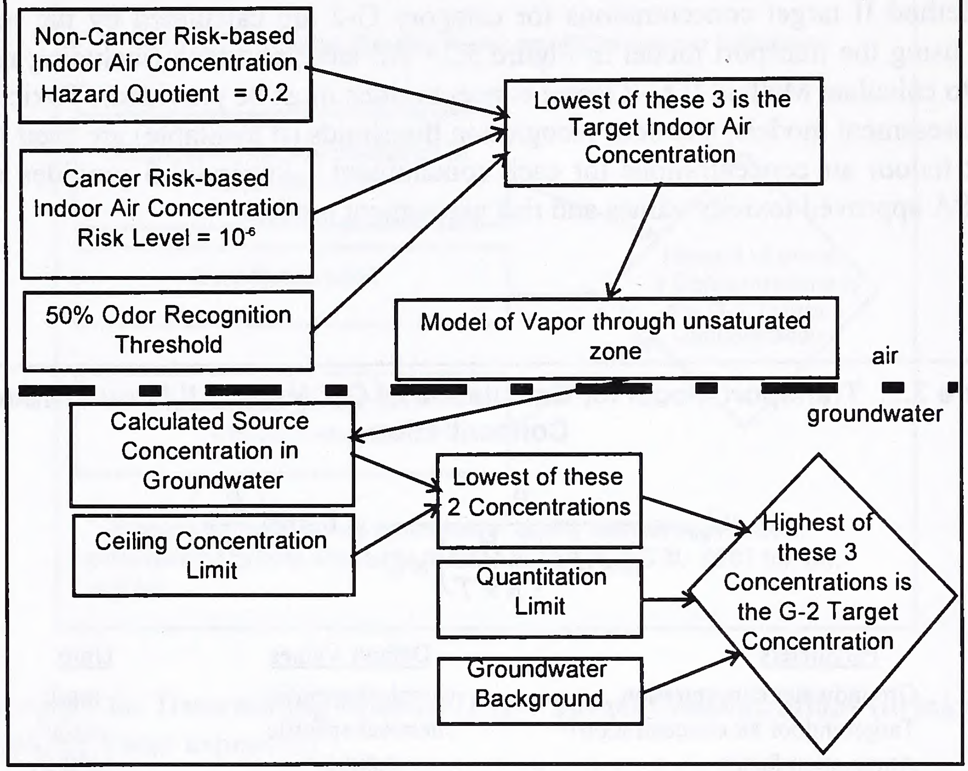
from MDEP, 1994.

The procedure for derivation of Method II G-2 target concentrations is shown in the flow chart in Figure 3.3 and outlined in the procedure below.

Figure 3.3. Method II Derivation of Target Concentrations for G-2

GROUNDWATER TO INDOOR AIR

(only Contaminants with Henry's Law constant > 10^{-5} atm-m^3/mole and a molecular weight < 200 g/mole)



Non-Cancer Risk-based Indoor Air Concentration Hazard Quotient = 0.2
Cancer Risk-based Indoor Air Concentration Risk Level = 10^{-6}
50% Odor Recognition Threshold
Lowest of these 3 is the Target Indoor Air Concentration
Model of Vapor through unsaturated zone
air
groundwater
Calculated Source Concentration in Groundwater
Ceiling Concentration Limit
Lowest of these 2 Concentrations
Quantitation Limit
Groundwater Background
Highest of these 3 Concentrations is the G-2 Target Concentration

Procedure for Determining Method II G-2 Target Concentrations (movement of contaminant from groundwater to indoor air)

For each contaminant use the following steps:

1 Determine Henry's Law constant and molecular weight. References must be provided.

2 Continue if Henry's Law constant is greater than 1×10^{-5} atm-m^3/mole and molecular weight is less than 200 g/mole. If these two criteria are not met, then a G-2 target concentration is not required for the contaminant and the next contaminant should be reviewed.

3 Calculate the Non-Cancer Risk-based Indoor Air Concentration (Air_{nc}) using Equation 1 shown in Figure 3.4.

4 Calculate the Cancer Risk-based Indoor Air Concentration (Air_c) using Equation 2 shown on Figure 3.4.

5 Determine the 50% odor thresholds. References must be provided.

6 Take the lowest of the three concentrations from steps 3, 4, and 5 as the target indoor air concentration (P_{air}).

7 Input the target indoor air concentration identified in step 6 into the transport model in Figure 3.2.

8 Determine the Ceiling Concentration Limit by taking the lower of the 50% of the solubility (mg/l) of the contaminant and 1000 times the applicable groundwater quality standard or interim standard established by 15A NCAC 2L .0202. References must be provided.

9 Identify the lowest of the two concentrations identified in steps 7 and 8.

10 Calculate the quantitation limit for the particular analytical method used. See Appendix 2.

11 Identify the site-specific, naturally-occurring groundwater background concentration from the site assessment, if available. See Chapter 4C for guidance.

12 Take the highest of the three concentrations from steps 9, 10 and 11 as the Method II target concentration for G-2 category.

Method II Category G-3 Target Concentrations (movement of contaminant from groundwater to surface water)

Method II allows G-3 contaminant target concentrations to be calculated for compounds not found in Table 3.2 or if the detected contaminant concentration is above the target concentration listed in the table. This method allows the use of naturally occurring background concentrations and quantitation limits to determine Method II G-3 target concentrations. Method II G-3 should be used if one of the following exists at a site:

- Plume leading edge is less than 250 feet from the surface water body;
- Groundwater plume length is greater than 100 feet; and
- Potentially impacted surface water is classified as trout waters (Tr), water supply (WS-I through WS-V) or future water supply (FWS).

However, if the groundwater plume is located in fractured bedrock or if the groundwater saturated thickness above bedrock is less than 15 feet, then the responsible party must use Method III which allows more complex modeling or a site-specific risk assessment, contingent upon departmental approval, may be conducted. All steps, data, and references used to calculate the G-3 target concentration must be provided to the appropriate regulatory program(s).

Method II G-3 target concentrations are calculated by the responsible party using the procedures shown in Figure 3.5. Step-by-step procedures follow the figure.

Figure 3.4. Equations For Use In Calculating Target Indoor Air Concentrations

Equation 1 - Non-Cancer Risk-based Indoor Air Concentration - Air_{nc} (mg/m^3)

$$Air_{nc} = 0.2 \times RfC$$

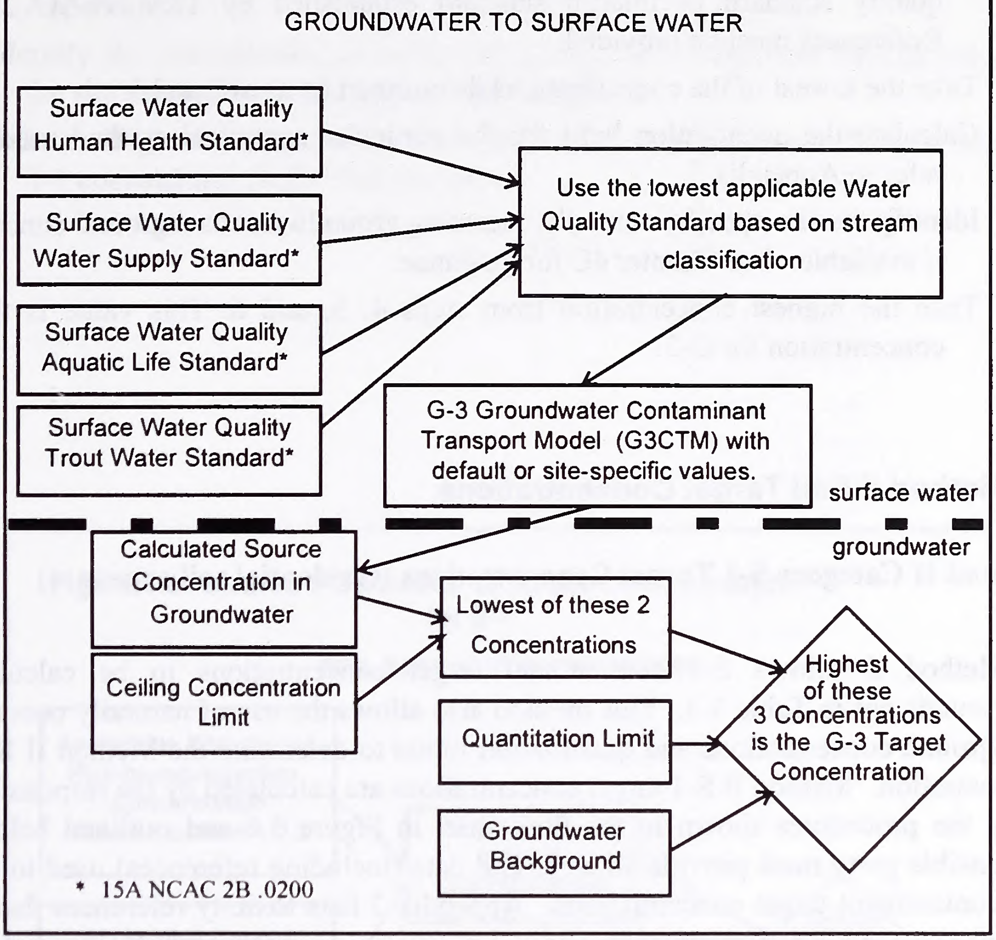
	Parameters	Units
Air_{nc}	Non-Cancer Risk-based Indoor Air Concentration.	mg/m^3
0.2	Target Hazard Quotient of 20%	Unitless
RfC	The Inhalation Reference Concentration or substitute toxicity value identified for the contaminant.	mg/m^3

Equation 2 - Cancer Risk-based Indoor Air Concentration - Air_c (mg/m^3)

$$Air_c = \frac{10^{-6}}{IUR \times 1000\,\mu g / mg}$$

	Parameters	Units
Air_c	Cancer Risk-based Indoor Air Concentration.	mg/m^3
10^{-6}	Target Excess Lifetime Cancer Risk	unitless
IUR	EPA Inhalation Unit Risk	(ug/m^3)$^{-1}$

Figure 3.5. Method II Derivation of Target Concentrations for G-3


GROUNDWATER TO SURFACE WATER
Surface Water Quality Human Health Standard*
Surface Water Quality Water Supply Standard*
Surface Water Quality Aquatic Life Standard*
Surface Water Quality Trout Water Standard*
Use the lowest applicable Water Quality Standard based on stream classification
G-3 Groundwater Contaminant Transport Model (G3CTM) with default or site-specific values.
surface water
groundwater
Calculated Source Concentration in Groundwater
Ceiling Concentration Limit
Lowest of these 2 Concentrations
Quantitation Limit
Groundwater Background
Highest of these 3 Concentrations is the G-3 Target Concentration
* 15A NCAC 2B .0200

Procedure for Determining Method II G-3 Target Concentrations (groundwater-to-surface water)

For each contaminant use the following steps:

1 Determine the applicable surface water quality standard. If no surface water quality standard exists for a particular contaminant, contact the Division of Water Quality. For High Quality Waters (HQW) and Outstanding Resource Waters (ORW), use one-half of the relevant Class "C" surface water quality standard as the applicable surface water quality standard.[†]

[†] Note: Surface water in North Carolina can have several different classifications depending on the uses and aquatic life present in the waters. Each classification has a different set of surface water quality standards or criteria associated with it. In order to determine if groundwater discharge to surface water has the potential to violate surface water quality standards or criteria, one must first determine how a surface water body is classified. The surface water quality standards for each classification must be reviewed. The

2 Determine the Calculated Source Concentration using the G-3 Groundwater Contaminant Transport Model (Appendix 6) with default or site-specific values.

3 Determine the Ceiling Concentration Limit by taking the lower of the 50% of the solubility (mg/l) of the contaminant and 1000 times the applicable groundwater quality standard or interim standard established by 15A NCAC 2L .0202. References must be provided.

4 Take the lowest of the concentrations determined in steps 2 and 3.

5 Calculate the quantitation limit for the particular analytical method used. Please refer to Appendix 2.

6 Identify the site-specific naturally occurring groundwater background concentration, if available. See Chapter 4C for guidance.

7 Take the highest concentration from steps 4, 5, and 6. This value is the target concentration for G-3.

Method II Soil Target Concentrations

Method II Category S-1 Target Concentrations (residential soil exposure)

Method II allows S-1 contaminant target concentrations to be calculated for compounds not in Table 3.3. This method also allows the use of naturally occurring soil background concentrations and quantitation limits to determine the Method II S-1 target concentration. Method II S-1 target concentrations are calculated by the responsible party using the procedures shown in the flow chart in Figure 3.6 and outlined below. The responsible party must provide all steps and data (including references) used to calculate S-1 contaminant target concentrations. Appendix 3 lists toxicity references that may be used for Method II S-1 calculations.

Procedure for Determining Method II S-1 Target Concentrations (residential ingestion of soil)

For each contaminant use the following steps:

1 Calculate the Non-cancer Risk-based Residential Ingestion Concentration ($Soil_{nc}$) using Equation 1 from Figure 3.7.

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most stringent of those standards, based on site classification, is to be used in these calculations. Information on the surface water quality classifications and standards is available from the Division of Water Quality Regional Offices and through the Department home page (http://pluto.ehnr.state.nc.us).

2. Calculate the Cancer Risk-based Residential Ingestion Concentration ($Soil_c$) using Equation 2 from Figure 3.7.
3. Retain the lowest concentration from steps 1 and 2.
4. Calculate the quantitation limit for the particular analytical method used. See Appendix 2.
5. Identify the site-specific, naturally-occurring soil background concentration from the site assessment, if available. See Chapter 4C.
6. Take the highest of the concentrations identified in step 3, 4 and 5 as the Method II S-1 contaminant target concentration.

Figure 3.6. Method II Derivation of Target Concentrations for S-1

SOIL RESIDENTIAL EXPOSURES

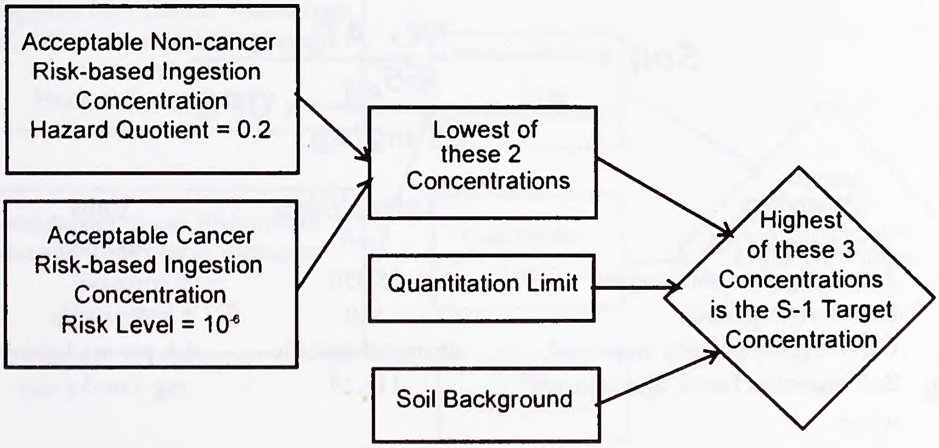

Acceptable Non-cancer Risk-based Ingestion Concentration Hazard Quotient = 0.2
Acceptable Cancer Risk-based Ingestion Concentration Risk Level = 10^{-6}
Lowest of these 2 Concentrations
Quantitation Limit
Soil Background
Highest of these 3 Concentrations is the S-1 Target Concentration

Figure 3.7. Equations For Use in Calculating S-1 Soil Target Concentrations.

Equation 1 - Non-cancer Risk-based Residential Ingestion Concentration - Soil_{nc} (mg/kg)

$$Soil_{nc} = \frac{THQ \times RfD_o \times BW_c \times AT_n}{EF_r \times ED_c \times \dfrac{IRS_c}{10^6\ mg/\ kg}}$$

	Parameters	Default Values	Units
THQ	Target Hazard Quotient	0.2	unitless
RfD_O	Reference dose oral	chemical-specific	mg/kg/day
BW_C	Body weight, age 1-6	15	kg
AT_n	Averaging time noncarcinogens	2,190	days
EF_r	Exposure frequency	350	days/year
ED_C	Exposure Duration, age 1-6	6	years
IRS_C	Soil ingestion, age 1-6	200	mg/day

Equation 2 - Cancer Risk-based Residential Ingestion Concentration - Soil_c (mg/kg)

$$Soil_c = \frac{TR \times AT_c}{EF_r \times \dfrac{IFS_{adj}}{10^6\ mg/\ kg} \times CPS_o}$$

	Parameters	Default Values	Units
TR	Target cancer risk	10^{-6}	unitless
AT_C	Averaging time carcinogens	25,550	days
EF_r	Exposure frequency	350	days/year
CPS_O	Carcinogenic potency slope oral	chemical-specific	risk per mg/kg/day
IFS_{adj}	Soil ingestion factor, age adjusted	114.29	mg-year/kg-day

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_{tot} - ED_c) \times IRS_a}{BW_a}$$

	Parameters	Default Values	Units
ED_C	Exposure duration, age 1-6	6	years
IRS_C	Soil ingestion, age 1-6	200	mg/day
BW_C	Body weight, age 1-6	15	kg
ED_{tot}	Exposure duration, total	30	years
IRS_a	Soil ingestion, adult	100	mg/day
BW_a	Body weight, adult	70	kg

from EPA, 1996c.

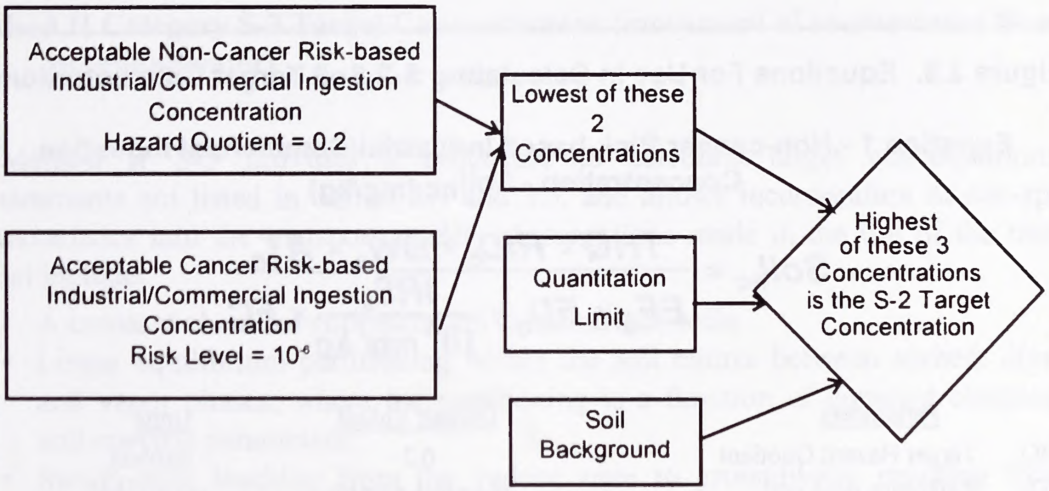
Method II Category S-2 Target Concentrations (industrial/commercial soil exposure)

Method II category S-2 allows the responsible party to calculate target concentrations for contaminants not listed in Table 3.3. This method also allows the use of naturally occurring soil background concentrations and quantitation limits to determine the Method II S-2 target concentration. S-2 contaminant target concentrations are derived using standard EPA risk assessment equations for the ingestion of soil in industrial/commercial exposures (EPA 1996c).

The procedure for deriving Method II S-2 target concentrations is shown in the flow chart in Figure 3.8 and outlined in the procedure below. Equations and default parameters used for calculating S-2 target concentrations are presented in Figure 3.9.

Figure 3.8. Method II Derivation of Target Concentrations for S-2

SOIL INDUSTRIAL/COMMERCIAL EXPOSURES


Acceptable Non-Cancer Risk-based Industrial/Commercial Ingestion Concentration Hazard Quotient = 0.2
Acceptable Cancer Risk-based Industrial/Commercial Ingestion Concentration Risk Level = 10⁻⁶
Lowest of these 2 Concentrations
Quantitation Limit
Soil Background
Highest of these 3 Concentrations is the S-2 Target Concentration

Procedure for Determining Method II S-2 Target Concentrations (industrial/ commercial exposure to soil)

For each contaminant use the following steps:

1. Calculate the Non-cancer Risk-based Industrial/Commercial Ingestion Concentration ($Soil_{nc}$) corresponding to a hazard quotient of 0.2 using Equation 1 from Figure 3.9.
2. Calculate the Cancer Risk-based Industrial/Commercial Ingestion Concentration ($Soil_c$) corresponding to an excess lifetime cancer risk equal to one-in one-million (1×10^{-6}) using Equation 2 from Figure 3.9.
3. Retain the lowest concentration from steps 1 and 2.
4. Calculate the quantitation limit for the particular analytical method used. See Appendix 2.
5. Identify the site-specific, naturally-occurring soil background concentration from the site assessment, if available. See Chapter 4C.
6. Take the highest of the concentrations identified in steps 3, 4, and 5 as the Method II S-2 contaminant target concentration.

Figure 3.9. Equations For Use In Calculating S-2 Soil Target Concentrations

Equation 1 - Non-cancer Risk-based Industrial/Commercial Ingestion Concentration - $Soil_{nc}$ (mg/kg)

$$Soil_{nc} = \frac{THQ \times RfD_o \times BW_a \times AT_n}{EF_o \times ED_o \times \frac{IRS_a}{10^6\ mg/kg} \times FC}$$

	Parameters	Default Values	Units
THQ	Target Hazard Quotient	0.2	unitless
RfD_o	Reference dose oral	chemical-specific	mg/kg/day
BW_a	Body weight, adult	70	kg
AT_n	Averaging time noncarcinogens	9125	days
EF_o	Exposure frequency	250	days/year
ED_o	Exposure Duration, adult	25	years
IRS_a	Soil ingestion, adult	100	mg/day
FC	Fraction of contaminated soil ingested	0.5	unitless

continued on next page

Figure 3.9. Continued.

Equation 2 - Cancer Risk-based Industrial/Commercial Ingestion Concentration - Soil$_C$ (mg/kg)

$$Soil_c = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \times \frac{IRS_a}{10^6\ mg/kg} \times FC \times CPS_o}$$

	Parameters	Default Values	Units
TR	Target cancer risk	10^{-6}	unitless
BW_a	Body weight, adult	70	kg
AT_c	Averaging time carcinogens	25,550	days
EF_o	Exposure frequency	250	days/year
ED_o	Exposure duration	25	years
IRS_a	Soil ingestion, adult	100	mg/day
FC	Fraction of contaminated soil ingested	0.5	unitless
CPS_o	Carcinogenic potency slope oral	chemical-specific	risk per mg/kg/day

from EPA, 1996c.

Method II Category S-3 Target Concentrations (movement of contaminant from soil to groundwater)

Method II S-3 provides a procedure to calculate target concentrations for contaminants not listed in Tables 3.4 and 3.5, and allows incorporation of site-specific characteristics into the transport model. Assumptions made in the use of the transport model include:

- A constant chemical concentration in subsurface soils;
- Linear equilibrium partitioning within the soil matrix between sorbed, dissolved and vapor phases, where the partitioning is a function of constant chemical-and soil-specific parameters;
- Steady-state leaching from the vadose zone to groundwater resulting from the constant leaching rate I (cm/s);
- No loss of chemical as it leaches towards groundwater (that is no biodegradation); and
- Steady well-mixed dispersion of the leachate within a groundwater "mixing zone."

The transport model is used to calculate the soil contaminant target concentration that would not likely exceed the groundwater target concentration.

There are three subcategories of S-3 target concentrations corresponding to each groundwater category (S-3:G-1, S-3:G-2 and S-3:G-3). The S-3 target concentration for each contaminant should be compared to the other applicable soil target concentrations (categories S-1 or S-2), and the lowest concentration must be selected. The S-3 target concentrations are not applicable for direct discharge to surface waters.

The procedure for derivation of the Method II S-3 target concentration is shown in the flow chart in Figure 3.10 and outlined in the procedure below.

Procedure for Determining Method II S-3 Target Concentration (movement of contaminant from soil to groundwater)

For each contaminant use the following steps:

1 Use lowest applicable groundwater target concentration from Appendix 1 Worksheet A1.2, Table A.1.2, Column IV.

2 Input the concentration from Step 1 and appropriate default or site-specific values into the equations shown in Figure 3.11 to determine the calculated source concentration for the soil. Refer to Appendix 9 for chemical-specific values (i.e., K_{oc}, K_d, H').[†]

3 Calculate the quantitation limit for the particular analytical method used. See Appendix 2.

4 Identify the site-specific, naturally occurring soil background concentration from the site assessment, if available. See Chapter 4C.

5 Take the highest of the concentrations identified in steps 2, 3, and 4 as the Method II S-3 target concentration.

[†] Other chemical-specific values may be used in the transport model, if it can be demonstrated to the satisfaction of the regulatory programs, that these values are appropriate. If a chemical is not listed in Appendix 9, refer to the references provided to obtain chemical-specific values.

Figure 3.10. Method II Derivation of Target Concentrations for S-3

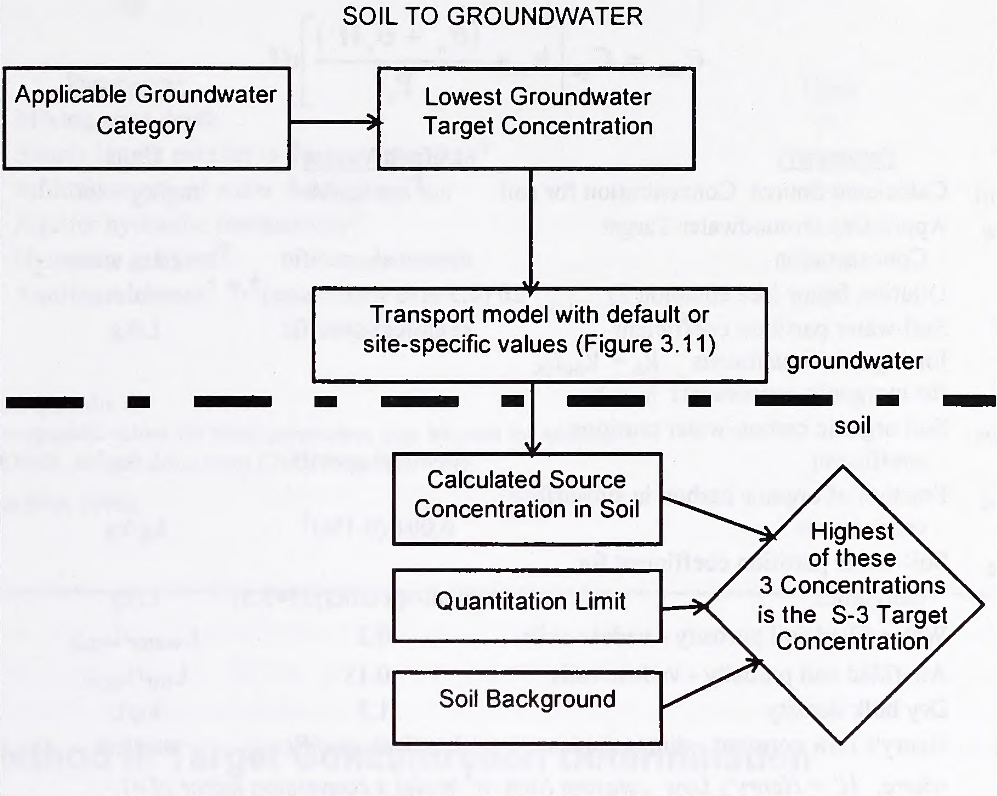

SOIL TO GROUNDWATER
Applicable Groundwater Category
Lowest Groundwater Target Concentration
Transport model with default or site-specific values (Figure 3.11)
groundwater
soil
Calculated Source Concentration in Soil
Quantitation Limit
Soil Background
Highest of these 3 Concentrations is the S-3 Target Concentration

Figure 3.11. Transport Model For Calculation of S-3 Soil Target Concentrations

Equation 1 - General Formula for S-3 Soil Concentrations Protective of Groundwater

$$\mathbf{C}_{soil} = \mathbf{C}_{gw}\left[\mathbf{k}_s + \frac{(\theta_w + \theta_a \mathbf{H'})}{\mathbf{P}_b}\right]\mathbf{df}$$

	Parameters	Default Values*	Units
C_{soil}	Calculated Source Concentration for soil	not applicable	mg/kg - soil
C_{gw}	Applicable Groundwater Target Concentration	chemical-specific	mg/L - water
df	Dilution factor (see equation 2)	20 (0.5 acre source size)†,‡	unitless
k_s	Soil-water partition coefficient for organic constituents $k_s = k_{oc}f_{oc}$ for inorganic constituents $k_s = k_d$	chemical-specific	L/kg
k_{oc}	Soil organic carbon-water partition coefficient	chemical-specific	L/kg
f_{oc}	Fraction of organic carbon in subsurface vadose soils	0.001 (0.1%)†	kg/kg
k_d	Soil-water partition coefficient for inorganics	chemical-specific(pH=5.5)	L/kg
θ_w	Water-filled soil porosity - vadose soils	0.3	L_{water}/L_{soil}
θ_a	Air-filled soil porosity - vadose soils	0.13	L_{air}/L_{soil}
P_b	Dry bulk density	1.5	kg/L
H'	Henry's Law constant - dimensionless	chemical-specific	unitless

where: H' = Henry's Law constant (atm-m^3/mole) x conversion factor of 41.

Equation 2 - Derivation of Dilution Factor

$$df = 1 + \frac{kid}{IL}$$

	Parameters	Units
df	Dilution factor	unitless
k	Aquifer hydraulic conductivity†	m/yr
i	Hydraulic gradient†	m/m
I	Infiltration rate of water through soil†	m/yr
d	Mixing zone depth (see Equation 3)†	m
L	Source length parallel to groundwater flow†	m

continued on next page

Figure 3.11. Continued.

Equation 3 - Estimation of Mixing Zone Depth

$$d = \left(0.0112L^2\right)^{0.5} + d_a\left[1 - e^{\left(\frac{-LI}{kid_a}\right)}\right]$$

	Parameters	Units
d	Mixing zone depth	m
L	Source length parallel to groundwater flow†	m
I	Infiltration rate of water through soil†	m/yr
k	Aquifer hydraulic conductivity†	m/yr
i	Hydraulic gradient†	m/m
d_a	Aquifer thickness†	m

* See Appendix 6.
† Site-specific values for these parameters may be used for Method II.
✢ DEHNR default value from EPA 1996a.

Based on EPA 1996a.

E. Method III Target Concentration Determination

Method III allows the use of models other than those discussed in this framework for calculating target concentrations at sites within the G-2, G-3 and S-3 categories. Prior to use of this method, the Department should be consulted to determine if another model is justified. Other than the models presented in this framework, the Department is not recommending specific models. However, any model used should meet the following requirements:

- Thoroughly documented in readily accessible published format;
- Peer-reviewed in the scientific literature;
- Available in the public domain in source code format (preferred but not required); and
- Appropriate to the site under investigation.

Appendix 10 provides additional guidance for groundwater modeling (G-3) and Figure 3.12 shows the minimum documentation required for modeling contaminants from groundwater to indoor air (G-2) or from soil to groundwater (S-3).

Figure 3.12. Minimum Documentation Required for Modeling Transport of Groundwater Contaminants to Indoor Air or Soil Contaminants to Groundwater.

- Name, version and developer of the model;
- Type of site for which the model is applicable;
- Critical conceptual assumptions inherent in the model;
- Critical conceptual assumptions and estimates of input values made by the modeler;
- Calibration process used by the modeler:
- Range of values used and the results of sensitivity analyses on critical data inputs; and
- Graphical representation and narrative explanation of the modeling results.

Method III Groundwater Target Concentrations

Method III G-2 (movement of contaminant from groundwater to indoor air)

The responsible party uses the procedures for determining Method II G-2 target concentrations, except that a different transport model would be used in Step 7. The model, assumptions and values used in Step 7 must be well documented. Refer to Figure 3.12 for the minimum documentation required for modeling for G-2 category.

Method III G-3 (groundwater-to-surface water)

The responsible party uses the procedures for determining Method II G-3 target concentrations, except that a different transport model would be used in Step 2. The model, assumptions and values used in Step 2 must be well documented. Refer to Appendix 10 for guidance on groundwater modeling.

Method III Soil Target Concentrations

Method III S-3 (movement of contaminant from soil to groundwater)

This is the only soil category that uses a model. Therefore, it is the only category for which Method III applies. The responsible party uses the procedures for determining Method II S-3 target concentrations, except a different transport model is used in Step 2. If a computer transport model is used, see EPA 1996a for guidance on use and applicability of various well-known transport models. The minimum documentation required when Method III is used is listed in Figure 3.12. All other steps are the same as Method II S-3.

F. Ceiling Concentration Limits

Ceiling Concentration Limits (CCL) for groundwater are used in determining the target concentrations for sites in the G-2 and G-3 categories. In addition, these limits must be met at sites where none of the groundwater categories apply. The maximum contaminant level in groundwater at these sites must not exceed the CCL. The presence of a non-aqueous phase liquid in groundwater shall be considered a level that exceeds the CCL. The CCL for each contaminant is the lower of:

- 50 percent (%) of the aqueous solubility of the compound or
- 1000 times the groundwater quality standard or the interim established in 15A NCAC 2L .0202.

G. Site-Specific Risk Assessment

A comprehensive site-specific risk assessment using a scientific approach such as that described in Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) may be conducted under some circumstances. A site-specific risk assessment is an alternative to Methods I, II and III, and cannot be used in conjunction with those Methods. The use of a site-specific risk assessment by a responsible party must be approved by the regulatory program that has authority over the site.

Site-specific risk assessment procedures and requirements are described in general below. In some risk assessments, complex data analysis and interpretation issues may arise. These issues should be addressed by persons having the appropriate professional training and experience.

An assessment of the risk of harm to human health includes a hazard assessment, a dose-response assessment and an exposure assessment. Information from these three assessments is combined to characterize the risk of harm to human health. The hazard assessment and dose-response assessment for many chemicals have been performed by the EPA and the resulting toxicity values have undergone extensive peer review. These toxicity values are published in the EPA's Integrated Risk Information System (IRIS) database and should be used in the site-specific risk assessment.

The risk estimates for carcinogens at each site will be based on EPA cancer slope factors and Inhalation Unit Risks. The noncancer risk estimates will be based on EPA Reference Doses (RfD) and Reference Concentrations (RfC). If no toxicity value for a contaminant is available in IRIS, then refer to Appendix 3 for a list of references that may be used.

The exposure assessment provides an estimate of the type and magnitude of exposure to contaminants present at a site and includes quantification of the magnitude, frequency and duration of exposures for current and future populations. The default exposure assumptions outlined in RAGS (EPA 1989) should be considered in the site-specific risk assessment. Deviation from default exposure assumptions recommended in the RAGS document may be considered only in exceptional circumstances when evidence supporting alternate exposure assumptions is accepted by the regulatory agency or if updated EPA default assumptions become available.

Risk characterization includes review of toxicity and exposure assessments, quantification of risks from individual and multiple chemicals, and combination of risks across multiple exposure pathways. The responsible party must quantify the risk associated with exposure to each contaminant and use this information to assess the cumulative (or aggregate) carcinogenic and noncarcinogenic risk across all applicable exposure pathways for each receptor population.

At sites that are in the G-1 category, the groundwater contaminant concentrations must not exceed the groundwater quality standards or interim standards established in 15A NCAC 2L .0202. The risk associated with exposure to contaminant concentrations in groundwater used for drinking must be considered in the calculation of the total cumulative risk at the site.

The additive effects of contaminants in all media and exposure pathways for each receptor must be considered when calculating site-specific target concentrations. The responsible party must provide all steps and data (including references) used to calculate the site-specific target concentrations.

References that may be used for conducting a site-specific risk assessment are listed in Appendix 3. Other references and guidance may be used, subject to approval by the appropriate Departmental regulatory agency.

H. Ecological Risk Assessment

In addition to the exposures identified for the groundwater and soil categories, ecological exposures may need to be evaluated (e.g., protection of sensitive species and habitats). Environmental assessment of contaminated sites will be required to evaluate whether or not environmental harm is apparent. The assessment will include identification of current and potential environmental receptors and determination of receptor exposure pathways. Special consideration must be given to wetlands, endangered species and wildlife refuges. The responsible party must provide all steps and data (including references) used to conduct the environmental assessment. EPA guidance on ecological risk assessment is available; these documents are listed in the reference section (EPA 1992, 1995b and 1996b).

The soil and groundwater categories in Methods I, II and III were chosen to protect surface water and groundwater standards and will be sufficient to protect a majority of the ecological receptors; however, where endangered species, wetlands and wildlife refuges are present, the regulatory program that has authority over the site must be consulted. Additional data collection and analysis may be necessary for these sites. In the case of areas with special geological or hydrological characteristics, additional modeling may be needed to ensure that assumptions made within the equations and models apply. Again, the regulatory program that has authority over the site must be notified and has final approval of the assessment.

Specific procedures are not listed for conducting ecological assessments because they will be site-specific. Assessment and development of alternate target concentrations for protection of ecological receptors will be conducted under supervision of the appropriate regulatory program. It is not anticipated that many sites will require this type of assessment because the target concentrations developed using Methods I, II and III address the most common receptors and the potential risk of harm to human health, public welfare and the environment.

Table 3.1. Target Concentrations for Method I G-1 and G-2 Groundwater Categories.*

		METHOD I TARGET CONCENTRATIONS (mg/L)	
COMPOUNDS	CAS #	G-1	G-2
ACENAPHTHENE	83329	0.08	
ACENAPHTHYLENE	208968	0.21	
ACETONE	67641	0.7	
ACRYLAMIDE (PROPENAMIDE)	79061	0.00001	
ANTHRACENE	120127	2.1	
ARSENIC	7440382	0.05	
ATRAZINE	1912249	0.003	
BARIUM	7440393	2	
BENZENE	71432	0.001	0.01027
BENZO (A) ANTHRACENE	56553	0.0000479	
BENZO (G,H,I) PERYLENE	191242	0.21	
BIS (2-CHLOROETHYL) ETHER	111444		0.10862
BIS (2-CHLOROISO-PROPYL) ETHER	39638329		0.41416
BORON	7440428	0.32	
BROMODICHLOROMETHANE	75274	0.00056	
BROMOFORM (TRIBROMOMETHANE)	75252	0.00019	
BROMOMETHANE	74839		0.00238
BUTYLBENZYL PHTHALATE	85687	0.1	
CADMIUM	7440439	0.005	
CAPROLACTAM	105602	3.5	
CARBOFURAN	1563662	0.036	
CARBON DISULFIDE	75150	0.7	
CARBON TETRACHLORIDE	56235	0.0003	0.00106
CHLORDANE	57749	0.000027	
CHLOROBENZENE	108907	0.05	0.47598
CHLOROETHANE	75003	2.8	
CHLOROFORM (TRICHLOROMETHANE)	67663	0.00019	0.006
CHLOROPHENOL 2-	95578	0.0001	
CHROMIUM	7440473	0.05	
CHRYSENE	218019	0.00479	
CIS-1,2-DICHLOROETHENE	156592	0.07	
COPPER	7440508	1	
CYANIDE	57125	0.154	
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE (DEHP)	117817	0.003	
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742	0.7	
DI-N-OCTYL PHTHALATE	117840	0.14	
DIBROMO-3-CHLOROPROPANE 1,2-	96128	0.000025	
DICHLOROBENZENE 1,2 (O-DCB)	95501	0.62	6.75464
DICHLOROBENZENE 1,3 (M-DCB)	541731	0.62	
DICHLOROBENZENE 1,4 (P-DCB)	106467	0.075	27.581
DICHLORODIFLUOROMETHANE (FREON-12; HALON)	75718	1.4	
DICHLOROETHANE 1,1	75343	0.7	8.59574

Table 3.1. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/L)	
		G-1	G-2
DICHLOROETHYLENE 1,1 (VINYLIDENE CHLORIDE)	75354	0.007	0.00063
DICHLOROPHENOXY ACETIC ACID 2,4 (2,4-D)	94757	0.07	
DICHLOROPROPANE 1,2-	78875	0.00056	0.13243
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756	0.00019	0.0036
DIETHYLPHTHALATE (DEP)	84662	5	
DIOXIN 2,3,7,8-TCDD ONLY	1746016	2.2E-10	
DIPHENYL (BIPHENYL)	92524	0.35	
DIUNDECYL PHTHALATE (SANTICIZER 711)	3648202	0.14	
ENDRIN	72208	0.002	
EPICHLOROHYDRIN (1-CHLORO-2,3-EPOXYPROPANE)	106898	0.00354	
ETHYLBENZENE	100414	0.029	27.3159
ETHYLENE DIBROMIDE (EDB, 1,2-DIBROMOETHANE)	106934	0.0000004	0.0004
ETHYLENE GLYCOL	107211	7	
FLUORANTHENE	206440	0.28	
FLUORENE	86737	0.28	
FLUORIDE	7782414	2	
HEPTACHLOR	76448	0.000008	
HEPTACHLOR EPOXIDE	1024573	0.000004	
HEPTANE	142825	2.1	
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741	0.00002	
IRON	7439896	0.3	
ISOPROPYL ETHER (DIISOPROPYL ETHER)	108203	0.07	
LEAD	7439921	0.015	
LINDANE (GAMMA-BHC)	58899	0.0002	
MANGANESE	7439965	0.05	
MERCURY	7439976	0.0011	
METHANOL	67561	3.5	
METHOXYCHLOR	72435	0.035	
METHYL ETHYL KETONE (MEK; 2-BUTANONE)	78933	0.17	170
METHYL ISOBUTYL KETONE (MIBK)	108101		54
METHYL TERT-BUTYL ETHER (MTBE)	1634044	0.2	200
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092	0.005	0.3131
N-HEXANE	110543	0.42	
NAPHTHALENE	91203	0.021	
NICKEL	7440020	0.1	
NITRATE (AS N)	14797558	10	

Table 3.1. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/L)	
		G-1	G-2
NITRITE (AS N)	14797650	1	
PENTACHLOROPHENOL	87865	0.0003	
PHENANTHRENE	85018	0.21	
PHENOL	108952	0.3	
PYRENE	129000	0.21	
SELENIUM	7782492	0.05	
SILVER	7440224	0.018	
SILVEX (2, 4, 5,-TP)	93721	0.05	
SIMAZINE	122349	0.0035	
STYRENE (ETHENYLBENZENE)	100425	0.1	35.8979
SULFATE	4808798	250	
TETRACHLOROETHANE 1,1,1,2-	630206		0.00575
TETRACHLOROETHANE 1,1,2,2-	79345		0.02123
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184	0.0007	0.39554
TOLUENE (METHYLBENZENE)	108883	1	5.59078
TOXAPHENE	8001352	0.000031	
TRICHLOROBENZENE 1,2,4-	120821		9.5
TRICHLOROETHANE 1,1,1 (METHYL CHLOROFORM)	71556	0.2	4.056
TRICHLOROETHANE 1,1,2-	79005		0.03214
TRICHLOROETHYLENE (TCE)	79016	0.0028	0.02993
TRICHLOROFLUORO-METHANE	75694	2.1	
VINYL CHLORIDE (CHLOROETHYLENE)	75014	0.000015	0.00002
XYLENES (O-, M-, AND P-)	1330207	0.53	5.32739
ZINC	7440666	2.1	

* The criteria used to determine Method I G-1 and G-2 target concentrations can be found in Appendices 4 and 5.

Table 3.2. Target Concentrations for Method I G-3 Groundwater Category*

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS G-3 (mg/kg)		
		250 feet**	500 feet**	1000 ft**
ACENAPHTHENE	83329	1.71	1.71	1.71
ACROLEIN	107028	1.95	3.9	7.8
ACRYLONITRILE	107131	0.00166	0.00333	0.00665
ALDRIN	309002	0.00000034	0.00000068	0.00000136
ALPHA-ENDOSULFAN	959988	0.0000225	0.000045	0.00009
ANTHRACENE	120127	0.645	0.645	0.645
ANTIMONY	7440360	10.8	21.5	430
ARSENIC	7440382	0.125	0.25	0.5
BENZENE	71432	0.179	0.357	0.714
BENZIDINE	92875	0.00000135	0.0000027	0.0000054
BENZO (B) FLUORANTHENE	205992	0.000123	0.000245	0.00049
BENZO (A) ANTHRACENE	56553	0.000123	0.000245	0.00049
BENZO (A) PYRENE	50328	0.000123	0.000245	0.00049
BENZO (G,H,I) PERYLENE	191242	0.000123	0.00013	0.00013
BENZO (K) FLUORANTHENE	207089	0.000123	0.000245	0.00049
BERYLLIUM	7440417	0.000293	0.00058	0.00117
BETA-ENDOSULFAN	33213659	0.000022	0.000045	0.00009
BIS (2-ETHYLHEXYL) PHTHALATE	117817	0.0148	0.0296	0.0592
BORON	7440428	1.88	3.75	7.5
BROMOFORM	75252	0.19	0.19	0.19
CADMIUM	7440439	0.005	0.01	0.02
CARBON TETRACHLORIDE	56235	0.011	0.0221	0.0442
CHLORDANE	57749	0.00000147	0.00000294	0.00000588
CHLORIDE		0.575	1.15	2.3
CHLORINE, TOTAL RESIDUAL		0.0425	0.085	0.17
CHLOROBENZENE	108907	50	50	50
CHLORODIBROMOMETHANE	124481	0.085	0.17	0.34
CHLOROETHYL ETHER (BIS-2)	111444	0.000051	0.000051	0.000051
CHLOROFORM	67663	0.19	0.19	0.19
CHLOROISOPROPYL ETHER (BIS-2)	108601	425	850	1700
CHROMIUM, TOTAL		0.05	0.1	0.2
CHRYSENE	218019	0.000123	0.000245	0.00049
COPPER	7440508	0.0075	0.015	0.03
CYANIDE	57125	0.0025	0.005	0.01
DDT	50293	0.00000148	0.00000296	0.00000591
DEMETON	8065483	0.00025	0.0005	0.001
DI-N-BUTYL PHTHALATE	84742	30	60	120
DIBENZO(A,H) ANTHRACENE	53703	0.000123	0.000245	0.00025
DICHLOROBENZENE 1,2	95501	42.5	72.5	72.5
DICHLOROBENZENE 1,3	541731	6.5	13	26
DICHLOROBENZIDINE 3,3'	91941	0.000193	0.000385	0.00077
DICHLOROBROMOMETHANE	75274	0.11	0.23	0.46
DICHLOROETHANE 1,2	107062	0.248	0.38	0.38
DICHLOROETHYLENE 1,1	75354	0.008	0.016	0.032
DICHLOROPHENOL 2,4	120832	1.98	3.95	7.9
DICHLOROPROPENE 1,3	542756	0.19	0.19	0.19

Table 3.2. Continued.

		METHOD I TARGET CONCENTRATIONS G-3 (mg/kg)		
COMPOUNDS	CAS #	250 feet**	500 feet**	1000 ft**
DIMETHYL PHTHALATE	131113	2500	2500	2500
DINITROPHENOL 2,4	51285	35	70	140
DINITROTOLUENE 2,4	121142	0.0228	0.0455	0.091
DIOXIN 2,3,7,8-TCDD ONLY	1746016	0.000000035	0.00000007	0.00000014
DIPHENYLHYDRAZINE 1,2	122667	0.00135	0.0027	0.0054
ENDOSULFAN SULFATE	1031078	0.000022	0.000045	0.00009
ENDRIN	72208	0.000005	0.00001	0.00002
ENDRIN ALDEHYDE	7421934	0.00203	0.00405	0.0081
ETHYLBENZENE	100414	29	29	29
FLUORANTHENE	206440	0.133	0.133	0.133
FLUORENE	86737	0.95	0.95	0.95
FLUORIDE	7782414	0.0045	0.009	0.018
GUTHION (AZINOPHOS METHYL)	86500	0.000025	0.00005	0.0001
HEPTACHLOR	76448	0.000000535	0.00000107	0.00000214
HEPTACHLOR EPOXIDE	1024573	0.000000275	0.00000055	0.0000011
HEXACHLOROBENZENE	118741	0.00000193	0.00000385	0.0000077
HEXACHLOROBUTADIENE	87683	0.124	0.249	0.497
HEXACHLOROCYCLOHEXANE-ALPHA	319846	0.0000325	0.000065	0.00013
HEXACHLOROCYCLOHEXANE-BETA	319857	0.00011	0.00023	0.00046
HEXACHLOROCYCLOPENTADIENE	77474	0.9	0.9	0.9
HEXACHLOROETHANE	67721	0.0223	0.0445	0.089
INDENO(1,2,3-CD) PYRENE	193395	0.000123	0.000245	0.00049
IRON	7439896	2.5	5	10
ISOPHORONE	78591	6.5	13	26
LEAD	7439921	0.0625	0.125	0.25
LINDANE (GAMMA-BHC)	58899	0.00001	0.00002	0.00004
MALATHION	121755	0.00025	0.0005	0.001
MANGANESE	7439965	0.25	0.5	1
MERCURY	7439976	0.00003	0.00006	0.00012
METHOXYCHLOR	72435	0.000075	0.00015	0.0003
METHYL BROMIDE	74839	10	20	40
METHYL-4,6-DINITROPHENOL (2-)	534521	1.91	3.83	7.65
METHYLENE CHLORIDE	75092	4	5	5
MIREX	2385855	0.0000025	0.000005	0.00001
N-NITROSODIPHENYLAMINE	86306	0.04	0.08	0.16
NICKEL	7440020	0.0208	0.0415	0.083
NITROBENZENE	98953	4.75	9.5	19
NITROSODIMETHYLAMINE N	62759	0.0203	0.0405	0.081
PARATHION	56382	0.0000325	0.000065	0.00013
PCB-1016	12674112	0.000198	0.000395	0.00079
PCB-1221	11104282	0.000198	0.000395	0.00079
PCB-1232	11141165	0.000198	0.000395	0.00079
PCB-1242	53469219	0.000198	0.000395	0.00079
PCB-1248	12672296	0.000198	0.000395	0.00079
PENTACHLOROPHENOL	87865	0.0198	0.0395	0.079
PHENANTHRENE	85018	0.0725	0.145	0.29

Table 3.2. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS G-3 (mg/kg) 250 feet**	500 feet**	1000 ft**
PHENOL	108952	300	300	300
PYRENE	129000	0.08	0.08	0.08
SELENIUM	7782492	0.0125	0.025	0.05
SILVER	7440224	0.00015	0.0003	0.0006
SILVEX (2,4,5-TP)	93721	0.00000148	0.00000295	0.0000059
TBTO	56359	0.000005	0.00001	0.00002
TETRACHLORETHANE (1,1,2,2)	79345	0.027	0.054	0.108
TETRACHLORETHYLENE	127184	0.0221	0.0443	0.0885
THALLIUM	7440280	0.0158	0.0315	0.063
TOLUENE	108883	0.0275	0.055	0.11
TOXAPHENE	8001352	0.0000005	0.000001	0.000002
TRICHLOROETHANE 1,1,2	79005	0.105	0.21	0.42
TRICHLOROETHYLENE	79016	0.231	0.462	0.924
TRICHLOROPHENOL 2,4,6	88062	0.0163	0.0325	0.065
VINYL CHLORIDE	75014	0.015	0.015	0.015
XYLENES, TOTAL	1330000	2	4	8
ZINC	7440666	0.125	0.25	0.5

* The criteria used to determine Method I G-3 target concentrations can be found in Appendix 6.

** These distances represent the distance of the groundwater plume's leading edge (PLE) to the surface water. Use the target concentrations under the 250 foot column for those PLEs >=250 feet and <500 feet from the surface water body. Use 500 foot column for those PLEs >=500 feet and <1000 feet from the surface water body and use 1000 feet for those PLEs >=1000 feet from the surface water body.

Table 3.3. Target Concentrations for Method I S-1 and S-2 Soil Categories.*

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	**CAS #**	**S-1**	**S-2**
ACEPHATE	30560191	73	660
ACETOCHLOR	34256821	320	8200
ACETONE	67641	1560	40000
ACETONE CYANOHYDRIN	75865	1100	28000
ACETONITRILE	75078	94	2400
ACETOPHENONE	98862	1560	40000
ACIFLUORFEN	62476599	200	5400
ACROLEIN	107028	320	8200
ACRYLAMIDE	79061	0.14	1.3
ACRYLIC ACID	79107	7800	200000
ACRYLONITRILE	107131	1.2	11
ALACHLOR	15972608	8	72
ALAR	1596845	2400	62000
ALDICARB	116063	15.6	400
ALDICARB SULFONE	1646884	15.6	400
ALDRIN	309002	0.038	0.34
ALKANES (**)			
C_5-C_8		938.6	24528
C_9-C_{18}		9386	245280
C_{19}-C_{32}		93860	2452800
ALLY	74223646	4000	102000
ALLYL ALCOHOL	107186	78	2000
ALLYL CHLORIDE	107051	780	20000
ALUMINUM	7429905	15600	200000
ALUMINUM PHOSPHIDE	20859738	6.2	164
AMDRO	67485294	4.6	122
AMETRYN	834128	140	3600
M-AMINOPHENOL	591275	1100	28000
4-AMINOPYRIDINE	504245	0.32	8.2
AMITRAZ	33089611	40	1020
AMMONIUM SULFAMATE	7773060	3200	82000
ANILINE	62533	110	1000
ANTIMONY AND COMPOUNDS	7440360	6.2	164
ANTIMONY PENTOXIDE	1314609	7.8	200
ANTIMONY POTASSIUM TARTRATE	304610	14	360
ANTIMONY TETROXIDE	1332316	6.2	164
ANTIMONY TRIOXIDE	1309644	6.2	164
APOLLO	74115245	200	5400
ARAMITE	140578	26	230
AROMATICS C_9-C_{32} (**)		469.2	12264
ARSENIC	7440382	4.6	122
ARSENIC (AS CARCINOGEN)	7440382	0.43	3.8
ASSURE	76578148	140	3600
ASULAM	3337711	780	20000
ATRAZINE	1912249	2.9	26

Table 3.3. Continued.

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S-1	S-2
AVERMECTIN B1	65195553	6.2	164
AZOBENZENE	103333	5.8	52
BARIUM AND COMPOUNDS	7440393	1100	28000
BAYGON	114261	62	1640
BAYLETON	43121433	460	12200
BAYTHROID	68359375	400	10200
BENEFIN	1861401	4600	122000
BENOMYL	17804352	780	20000
BENTAZON	25057890	40	1020
BENZALDEHYDE	100527	1560	40000
BENZENE	71432	22	200
BENZENETHIOL	108985	0.156	4
BENZIDINE	92875	0.0028	0.025
BENZOIC ACID	65850	62000	200000
BENZOTRICHLORIDE	98077	0.049	0.44
BENZYL ALCOHOL	100516	4600	122000
BENZYL CHLORIDE	100447	3.8	34
BERYLLIUM AND COMPOUNDS	7440417	0.15	1.3
BIDRIN	141662	1.56	40
BIPHENTHRIN (TALSTAR)	82657043	240	6200
1,1-BIPHENYL	92524	780	20000
BIS(2-CHLOROETHYL)ETHER	111444	0.58	5.2
BIS(2-CHLOROISOPROPYL)ETHER	39638329	9.1	82
BIS(CHLOROMETHYL)ETHER	542881	0.0029	0.026
BIS(2-CHLORO-1-METHYLETHYL)ETHER		9.1	82
BIS(2-ETHYLHEXYL)PHTHALATE (DEHP)	117817	46	410
BISPHENOL A	80057	780	20000
BORON (AND BORATES)	7440428	1400	36000
BROMODICHLOROMETHANE	75274	10	92
BROMOFORM (TRIBROMOMETHANE)	75252	81	720
BROMOMETHANE	74839	22	580
4-BROMOPHENYL PHENYL ETHER	101553	900	24000
BROMOPHOS	2104963	78	2000
BROMOXYNIL	1689845	320	8200
BROMOXYNIL OCTANOATE	1689992	320	8200
1-BUTANOL	71363	1560	40000
BUTYL BENZYL PHTHALATE	85687	3200	82000
BUTYLATE	2008415	780	20000
SEC-BUTYLBENZENE	135988	156	4000
TERT-BUTYLBENZENE	104518	156	4000
BUTYLPHTHALYL BUTYLGLYCOLATE	85701	15600	200000
CACODYLIC ACID	75605	46	1220
CADMIUM AND COMPOUNDS	7440439	7.8	200
CAPROLACTAM	105602	7800	200000
CAPTAFOL	2425061	74	670

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
CAPTAN	133062	180	1600
CARBARYL	63252	1560	40000
CARBOFURAN	1563662	78	2000
CARBON DISULFIDE	75150	1560	40000
CARBON TETRACHLORIDE	56235	4.9	44
CARBOSULFAN	55285148	156	4000
CARBOXIN	5234684	1560	40000
CHLORAL	75876	32	820
CHLORAMBEN	133904	240	6200
CHLORANIL	118752	1.6	14
CHLORDANE	57749	0.49	4.4
CHLORIMURON-ETHYL	90982324	320	8200
CHLORINE	7782505	1560	40000
CHLORINE CYANIDE	506774	780	20000
CHLOROACETALDEHYDE	107200	108	2800
CHLOROACETIC ACID	79118	32	820
4-CHLOROANILINE	106478	62	1640
CHLOROBENZENE	108907	320	8200
CHLOROBENZILATE	510156	2.4	21
P-CHLOROBENZOIC ACID	74113	3200	82000
4-CHLOROBENZOTRIFLUORIDE	98566	320	8200
2-CHLORO-1,3-BUTADIENE	126998	320	8200
1-CHLOROBUTANE	109693	6200	164000
CHLORODIBROMOMETHANE	124481	7.6	68
CHLOROETHANE	75003	6200	164000
2-CHLOROETHYL VINYL ETHER	110758	400	10200
CHLOROFORM	67663	100	940
CHLOROMETHANE	74873	49	440
4-CHLORO-2,2-METHYLANILINE HYDROCHLORIDE	3165933	1.4	12
4-CHLORO-2-METHYLANILINE	95692	1.1	9.9
BETA-CHLORONAPHTHALENE	91587	1260	32000
O-CHLORONITROBENZENE	88733	26	230
P-CHLORONITROBENZENE	100005	35	320
2-CHLOROPHENOL	95578	78	2000
CHLOROTHALONIL	1897456	58	520
O-CHLOROTOLUENE	95498	320	8200
CHLORPROPHAM	101213	3200	82000
CHLORPYRIFOS	2921882	46	1220
CHLORPYRIFOS-METHYL	5598130	156	4000
CHLORSULFURON	64902723	780	20000
CHLORTHIOPHOS	60238564	12.6	320
CHROMIUM III AND COMPOUNDS	16065831	15600	200000
CHROMIUM VI AND COMPOUNDS	18540299	78	2000
COBALT	7440484	940	24000

Table 3.3. Continued.

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S-1	S-2
COPPER AND COMPOUNDS	7440508	620	16400
CROTONALDEHYDE	123739	0.34	3
CUMENE	98828	620	16400
CYANIDES:			
BARIUM CYANIDE	542621	1560	40000
CALCIUM CYANIDE	592018	620	16400
COPPER CYANIDE	544923	78	2000
CYANAZINE	21725462	0.76	6.8
CYANOGEN	460195	620	16400
CYANOGEN BROMIDE	506683	1400	36000
CYANOGEN CHLORIDE	506774	780	20000
FREE CYANIDE	57125	320	8200
HYDROGEN CYANIDE	74908	320	8200
POTASSIUM CYANIDE	151508	780	20000
POTASSIUM SILVER CYANIDE	506616	3200	82000
SILVER CYANIDE	506649	1560	40000
SODIUM CYANIDE	143339	620	16400
THIOCYANATE		320	8200
ZINC CYANIDE	557211	780	20000
CYCLOHEXANONE	108941	78000	200000
CYCLOHEXLAMINE	108918	3200	82000
CYHALOTHRIN/KARATE	68085858	78	2000
CYPERMETHRIN	52315078	156	4000
CYROMAZINE	66215278	118	3000
DACTHAL	1861321	156	4000
DALAPON	75990	460	12200
DANITOL	39515418	400	10200
DDD	72548	2.7	24
DDE	72559	1.9	17
DDT	50293	1.9	17
DECABROMODIPHENYL ETHER	1163195	156	4000
DEMETON	8065483	0.62	16.4
DIALLATE	2303164	10	94
DIAZINON	333415	14	360
DIBENZOFURAN	132649	62	1640
1,4-DIBROMOBENZENE	106376	156	4000
1,2-DIBROMO-3-CHLOROPROPANE	96128	0.46	4.1
1,2-DIBROMOETHANE	106934	0.0075	0.067
DIBUTYL PHTHALATE	84742	1560	40000
DICAMBA	1918009	460	12200
1,2-DICHLOROBENZENE	95501	1400	36000
1,3-DICHLOROBENZENE	541731	1400	36000
1,4-DICHLOROBENZENE	106467	27	240
3,3'-DICHLOROBENZIDINE	91941	1.4	13
DICHLORODIFLUOROMETHANE	75718	3200	82000

Table 3.3. Continued.

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S-1	S-2
1,1-DICHLOROETHANE	75343	1560	40000
1,2-DICHLOROETHANE (EDC)	107062	7	63
1,1-DICHLOROETHYLENE	75354	1.1	9.5
1,2-DICHLOROETHYLENE (CIS)	156592	156	4000
1,2-DICHLOROETHYLENE (TRANS)	156605	320	8200
1,2-DICHLOROETHYLENE (MIXTURE)	540590	140	3600
2,4-DICHLOROPHENOL	120832	46	1220
2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)	94757	156	4000
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID	94826	126	3200
1,2-DICHLOROPROPANE	78875	9.4	84
2,3-DICHLOROPROPANOL	616239	46	1220
1,3-DICHLOROPROPENE	542756	3.7	33
DICHLORVOS	62737	2.2	20
DICOFOL	115322	1.5	13
DICYCLOPENTADIENE	77736	460	12200
DIELDRIN	60571	0.04	0.36
DIETHYL PHTHALATE	84662	12600	200000
DIETHYLENE GLYCOL, MONOETHYL ETHER	111900	32000	200000
DIETHYLFORAMIDE	617845	172	4400
DI(2-ETHYLHEXYL)ADIPATE	103231	530	4800
DIETHYLSTILBESTROL	56531	0.00014	0.0012
DIFENZOQUAT (AVENGE)	43222486	1260	32000
DIFLUBENZURON	35367385	320	8200
DIISOPROPYL METHYLPHOSPHONATE (DIMP)	1445756	1260	32000
DIMETHIPIN	55290647	320	8200
DIMETHOATE	60515	3.2	82
3,3'-DIMETHOXYBENZIDINE	119904	46	410
2,4-DIMETHYLANILINE HYDROCHLORIDE	21436964	1.1	9.9
2,4-DIMETHYLANILINE	95681	0.85	7.6
N-N-DIMETHYLANILINE	121697	32	820
3,3'-DIMETHYLBENZIDINE	119937	0.069	0.62
N,N-DIMETHYLFORMAMIDE	68122	1560	40000
1,1-DIMETHYLHYDRAZINE	57147	0.25	2.2
1,2-DIMETHYLHYDRAZINE	540738	0.017	0.15
2,4-DIMETHYLPHENOL	105679	320	8200
2,6-DIMETHYLPHENOL	576261	9.4	240
3,4-DIMETHYLPHENOL	95658	15.6	400
DIMETHYL PHTHALATE	131113	156000	200000
DIMETHYL TEREPHTHALATE	120616	1560	40000
1,2-DINITROBENZENE	528290	6.2	164

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg) S-1	S-2
1,3-DINITROBENZENE	99650	1.56	40
1,4-DINITROBENZENE	100254	6.2	164
4,6-DINITRO-O-CYCLOHEXYL PHENOL	131895	32	820
2,4-DINITROPHENOL	51285	32	820
DINITROTOLUENE MIXTURE		0.94	8.4
2,4-DINITROTOLUENE	121142	32	820
2,6-DINITROTOLUENE	606202	15.6	400
DINOSEB	88857	15.6	400
DI-N-OCTYL PHTHALATE	117840	320	8200
1,4-DIOXANE	123911	58	520
DIOXINS AND FURANS (**)			
2,3,7,8-HPCDD		0.00041	0.0037
2,3,7,8-HPCDF		0.00041	0.0037
2,3,7,8-HXCDD		0.000041	0.00037
2,3,7,8-HXCDF		0.000041	0.00037
OCDD	3268879	0.0041	0.037
OCDF		0.0041	0.037
2,3,7,8-PECDD		0.0000082	0.000074
1,2,3,7,8-PECDF	57117416	0.000082	0.00074
2,3,4,7,8-PECDF	57117314	0.0000082	0.000074
2,3,7,8-TCDD (DIOXIN)	1746016	0.0000041	0.000037
2,3,7,8-TCDF	51207319	0.000041	0.00037
DIPHENAMID	957517	460	12200
DIPHENYLAMINE	122394	400	10200
1,2-DIPHENYLHYDRAZINE	122667	0.8	7.2
DIQUAT	85007	34	900
DIRECT BLACK 38	1937377	0.074	0.67
DIRECT BLUE 6	2602462	0.079	0.71
DIRECT BROWN 95	16071866	0.069	0.62
DISULFOTON	298044	0.62	16.4
1,4-DITHIANE	505293	156	4000
DIURON	330541	32	820
DODINE	2439103	62	1640
EICOSANE (**)		93860	2452800
ENDOSULFAN	115297	94	2400
ENDOTHALL	145733	320	8200
ENDRIN	72208	4.6	122
EPICHLOROHYDRIN	106898	65	580
ETHEPHON (2-CHLOROETHYL PHOSPHONIC ACID)	16672870	78	2000
ETHION	563122	7.8	200
2-ETHOXYETHANOL ACETATE	111159	4600	122000
2-ETHOXYETHANOL	110805	6200	164000
ETHYL ACRYLATE	140885	13	120

Table 3.3. Continued.

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S-1	S-2
EPTC (S-ETHYL DIPROPYLTHIOCARBAMATE)	759944	400	10200
ETHYL ACETATE	141786	14000	200000
ETHYLBENZENE	100414	1560	40000
ETHYLENE CYANOHYDRIN	109784	4600	122000
ETHYLENE DIAMINE	107153	320	8200
ETHYLENE GLYCOL	107211	32000	200000
ETHYLENE OXIDE	75218	0.63	5.6
ETHYLENE THIOUREA (ETU)	96457	5.4	48
ETHYL ETHER	60297	3200	82000
ETHYL METHACRYLATE	97632	1400	36000
ETHYL P-NITROPHENYL PHENYLPHOSPHOROTHIOATE	2104645	0.156	4
ETHYLNITROSOUREA	759739	0.0046	0.041
ETHYLPHTHALYL ETHYL GLYCOLATE	84720	46000	200000
EXPRESS	10120	126	3200
FENAMIPHOS	22224926	4	102
FLUOMETURON	2164172	200	5400
FLUORIDE	7782414	940	24000
FLUORIDONE	59756604	1260	32000
FLURPRIMIDOL	56425913	320	8200
FLUTOLANIL	66332965	940	24000
FLUVALINATE	69409945	156	4000
FOLPET	133073	180	1600
FOMESAFEN	72178020	3.4	30
FONOFOS	944229	32	820
FORMALDEHYDE	50000	3200	82000
FORMIC ACID	64186	32000	200000
FOSETYL-AL	39148248	46000	200000
FURAN	110009	15.6	400
FURAZOLIDONE	67458	0.17	1.5
FURFURAL	98011	46	1220
FURIUM	531828	0.013	0.11
FURMECYCLOX	60568050	21	190
GLUFOSINATE-AMMONIUM	77182822	6.2	164
GLYCIDALDEHYDE	765344	6.2	164
GLYPHOSATE	1071836	1560	40000
HALOXYFOP-METHYL	69806402	0.78	20
HARMONY	79277273	200	5400
HCH (ALPHA)	319846	0.1	0.91
HCH (BETA)	319857	0.35	3.2
HCH (GAMMA) LINDANE	58899	0.49	4.4
HCH-TECHNICAL	608731	0.35	3.2
HEPTACHLOR	76448	0.14	1.3
HEPTACHLOR EPOXIDE	1024573	0.07	0.63

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
HEXABROMOBENZENE	87821	32	820
HEXACHLOROBENZENE	118741	0.4	3.6
HEXACHLOROBUTADIENE	87683	8.2	73
HEXACHLOROCYCLOPENTADIENE	77474	110	2800
HEXACHLORODIBENZO-P-DIOXIN MIXTURE	19408743	0.0001	0.00092
HEXACHLOROETHANE	67721	46	410
HEXACHLOROPHENE	70304	4.6	122
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	121824	5.8	52
N-HEXANE (**)	110543	938.6	24528
HEXAZINONE	51235042	520	13400
HYDRAZINE, HYDRAZINE SULFATE	302012	0.21	1.9
HYDROGEN SULFIDE	7783064	46	1220
HYDROQUINONE	123319	620	16400
IMAZALIL	35554440	200	5400
IMAZAQUIN	81335377	4000	102000
IPRODIONE	36734197	620	16400
IRON	7439896	4600	122000
ISOBUTANOL	78831	4600	122000
ISOPHORONE	78591	670	6000
ISOPROPALIN	33820530	240	6200
ISOPROPYL METHYL PHOSPHONIC ACID	1832548	1560	40000
ISOXABEN	82558507	780	20000
KEPONE	143500	0.035	0.32
LACTOFEN	77501634	32	820
LEAD (**)	7439921	400	400
LINURON	330552	32	820
LITHIUM	7439932	320	8200
LONDAX	83056996	3200	82000
MALATHION	121755	320	8200
MALEIC ANHYDRIDE	108316	1560	40000
MALEIC HYDRAZIDE	123331	7800	200000
MALONONITRILE	109773	0.32	8.2
MANCOZEB	8018017	460	12200
MANEB	12427382	78	2000
MANGANESE AND COMPOUNDS	7439965	360	9600
MEPHOSFOLAN	950107	1.4	36
MEPIQUAT CHLORIDE	24307264	460	12200
MERCURIC CHLORIDE	7487947	4.6	122
MERCURY (INORGANIC)	7439976	4.6	122
MERCURY (METHYL)	22967926	1.56	40
MERPHOS	150505	0.46	12.2
MERPHOS OXIDE	78488	0.46	12.2
METALAXYL	57837191	940	24000

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
METHACRYLONITRILE	126987	1.56	40
METHAMIDOPHOS	10265926	0.78	20
METHANOL	67561	7800	200000
METHIDATHION	950378	15.6	400
METHOMYL	16752775	400	10200
METHOXYCHLOR	72435	78	2000
2-METHOXYETHANOL ACETATE	110496	32	820
2-METHOXYETHANOL	109864	15.6	400
2-METHOXY-5-NITROANILINE	99592	14	120
METHYL ACETATE	79209	15600	200000
METHYL ACRYLATE	96333	460	12200
2-METHYLANILINE HYDROCHLORIDE	636215	3.5	32
2-METHYLANILINE	95534	2.7	24
METHYL CHLOROCARBONATE	79221	15600	200000
4-(2-METHYL-4-CHLOROPHENOXY) BUTYRIC ACID	94815	156	4000
2-METHYL-4-CHLOROPHENOXYACETIC ACID	94746	7.8	200
2-(2-METHYL-14-CHLOROPHENOXY)PROPIONIC ACID	93652	15.6	400
METHYLENE BROMIDE	74953	156	4000
METHYLENE CHLORIDE	75092	85	760
4,4'-METHYLENE BIS(2-CHLOROANILINE)	101144	4.9	44
4,4'-METHYLENEBISBENZENEAMINE	101779	2.6	23
4,4'-METHYLENE BIS(N,N'-DIMETHYL)ANILINE	101611	14	120
METHYL ETHYL KETONE	78933	9400	200000
METHYL HYDRAZINE	60344	0.58	5.2
METHYL ISOBUTYL KETONE	108101	1260	32000
METHYL METHACRYLATE	80626	1260	32000
2-METHYL-5-NITROANILINE	99558	19	170
METHYL PARATHION	298000	4	102
2-METHYLPHENOL (O-CRESOL)	95487	780	20000
3-METHYLPHENOL (M-CRESOL)	103394	780	20000
4-METHYLPHENOL (P-CRESOL)	106445	78	2000
METHYL STYRENE (MIXTURE)	25013154	94	2400
METHYL STYRENE (ALPHA)	98839	1100	28000
METHYL TERTBUTYL ETHER (MTBE)	1634044	78	2000
METOLACLOR (DUAL)	51218452	2400	62000
METRIBUZIN	21087649	400	10200
MIREX	2385855	0.35	3.2
MOLINATE	2212671	32	820
MOLYBDENUM	7439987	78	2000
MONOCHLORAMINE	10599903	1560	40000

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
NALED	300765	32	820
2-NAPHTHYLAMINE	91598	0.0049	0.044
NAPROPAMIDE	15299997	1560	40000
NICKEL AND COMPOUNDS	7440020	320	8200
NITRAPYRIN	1929824	24	620
NITRATE	14797558	26000	200000
NITRIC OXIDE	10102439	1560	40000
NITRITE	14797650	1560	40000
2-NITROANILINE	88744	0.94	24
3-NITROANILINE	99092	46	1220
4-NITROANILINE	100016	46	1220
NITROBENZENE	98953	7.8	200
NITROFURANTOIN	67209	1100	28000
NITROFURAZONE	59870	0.43	3.8
NITROGEN DIOXIDE	10102440	15600	200000
NITROGUANIDINE	556887	1560	40000
4-NITROPHENOL	100027	960	26000
N-NITROSODI-N-BUTYLAMINE	924163	0.12	1.1
N-NITROSODIETHANOLAMINE	1116547	0.23	2
N-NITROSODIETHYLAMINE	55185	0.0043	0.038
N-NITROSODIMETHYLAMINE	62759	0.013	0.11
N-NITROSODIPHENYLAMINE	86306	130	1200
N-NITROSO DI-N-PROPYLAMINE	621647	0.091	0.82
N-NITROSO-N-METHYLETHYLAMINE	10595956	0.029	0.26
N-NITROSOPYRROLIDINE	930552	0.3	2.7
M-NITROTOLUENE	99081	156	4000
O-NITROTOLUENE	88722	156	4000
P-NITROTOLUENE	99990	156	4000
N-NONANE (**)	111842	9386	245280
NORFLURAZON	27314132	620	16400
NUSTAR	85509199	11	280
OCTABROMODIPHENYL ETHER	32536520	46	1220
OCTAHYDRO-1357-TETRANITRO-1357-TETRAZOCINE	2691410	780	20000
OCTAMETHYLPYROPHOSPHORAMIDE	152169	32	820
ORYZALIN	19044883	780	20000
OXADIAZON	19666309	78	2000
OXAMYL	23135220	400	10200
OXYFLUORFEN	42874033	46	1220
PACLOBUTRAZOL	76738620	200	5400
PARAQUAT	1910425	70	1840
PARATHION	56382	94	2400
PEBULATE	1114712	780	20000
PENDIMETHALIN	40487421	620	16400

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
PENTABROMO-6-CHLORO CYCLOHEXANE	87843	28	250
PENTABROMODIPHENYL ETHER	32534819	32	820
PENTACHLOROBENZENE	608935	12.6	320
PENTACHLORONITROBENZENE	82688	2.5	22
PENTACHLOROPHENOL	87865	5.3	48
PERMETHRIN	52645531	780	20000
PHENMEDIPHAM	13684634	4000	102000
PHENOL	108952	9400	200000
M-PHENYLENEDIAMINE	108452	94	2400
P-PHENYLENEDIAMINE	106503	3000	78000
PHENYLMERCURIC ACETATE	62384	1.26	32
2-PHENYLPHENOL	90437	330	3000
PHORATE	298022	3.2	82
PHOSMET	732116	320	8200
PHOSPHINE	7803512	4.6	122
PHOSPHORUS (WHITE)	7723140	0.32	8.2
P-PHTHALIC ACID	100210	15600	200000
PHTHALIC ANHYDRIDE	85449	32000	200000
PICLORAM	1918021	1100	28000
PIRIMIPHOS-METHYL	29232937	156	4000
POLYBROMINATED BIPHENYLS		0.072	0.64
POLYCHLORINATED BIPHENYLS (PCBS)	1336363	0.083	0.74
AROCLOR 1016	12674112	1.1	28
AROCLOR 1254	11097691	0.32	8.2
POLYCHLORINATED TERPHENYLS (PCTS)		0.14	1.3
POLYNUCLEAR AROMATIC HYDROCARBONS			
ACENAPHTHENE	83329	940	24000
ANTHRACENE	120127	4600	122000
BENZ[A]ANTHRACENE	56553	0.88	7.8
BENZO[B]FLUORANTHENE	205992	0.88	7.8
BENZO[K]FLUORANTHENE	207089	8.8	78
BENZO[A]PYRENE	50328	0.088	0.78
CARBAZOLE	86748	32	290
CHRYSENE	218019	88	780
DIBENZ[AH]ANTHRACENE	53703	0.088	0.78
FLUORANTHENE	206440	620	16400
FLUORENE	86737	620	16400
INDENO[1,2,3-CD]PYRENE	193395	0.88	7.8
NAPHTHALENE	91203	620	16400
PYRENE (**)	129000	469.2	12264
PROCHLORAZ	67747095	4.3	38
PROFLURALIN	26399360	94	2400
PROMETON	1610180	240	6200

Table 3.3. Continued.

		METHOD I TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S-1	S-2
PROMETRYN	7287196	62	1640
PRONAMIDE	23950585	1180	30000
PROPACHLOR	1918167	200	5400
PROPANIL	709988	78	2000
PROPARGITE	2312358	320	8200
PROPARGYL ALCOHOL	107197	32	820
PROPAZINE	139402	320	8200
PROPHAM	122429	320	8200
PROPICONAZOLE	60207901	200	5400
PROPYLENE GLYCOL	57556	200000	200000
PROPYLENE GLYCOL, MONOETHYL ETHER	52125538	11000	200000
PROPYLENE GLYCOL, MONOMETHYL ETHER	107982	11000	200000
PROPYLENE OXIDE	75569	2.7	24
PURSUIT	81335775	4000	102000
PYDRIN	51630581	400	10200
PYRIDINE	110861	15.6	400
QUINALPHOS	13593038	7.8	200
QUINOLINE	91225	0.053	0.48
RESMETHRIN	10463868	460	12200
RONNEL	299843	780	20000
ROTENONE	83794	62	1640
SAVEY	78587050	400	10200
SELENIOUS ACID	7783008	78	2000
SELENIUM	7782492	78	2000
SELENOUREA	630104	78	2000
SETHOXYDIM	74051802	1400	36000
SILVER AND COMPOUNDS	7440224	78	2000
SIMAZINE	122349	5.3	48
SODIUM AZIDE	26628228	62	1640
SODIUM DIETHYLDITHIOCARBAMATE	148185	2.4	21
SODIUM FLUOROACETATE	62748	0.32	8.2
SODIUM METAVANADATE	13718268	15.6	400
STRONTIUM, STABLE	7440246	9400	200000
STRYCHNINE	57249	4.6	122
STYRENE	100425	3200	82000
SYSTHANE	88671890	400	10200
TEBUTHIURON	34014181	1100	28000
TEMEPHOS	3383968	320	8200
TERBACIL	5902512	200	5400
TERBUFOS	13071799	0.4	10.2
TERBUTRYN	886500	15.6	400
1,2,4,5-TETRACHLOROBENZENE	95943	4.6	122
1,1,1,2-TETRACHLOROETHANE	630206	25	220

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
1,1,2,2-TETRACHLOROETHANE	79345	3.2	29
TETRACHLOROETHYLENE (PCE)	127184	12	110
2,3,4,6-TETRACHLOROPHENOL	58902	460	12200
P,A,A,A-TETRACHLOROTOLUENE	5216251	0.032	0.29
TETRACHLOROVINPHOS	961115	27	240
TETRAETHYLDITHIOPYROPHOSPHATE	3689245	7.8	200
TETRAETHYL LEAD	78002	0.00156	0.04
THALLIC OXIDE	1314325	1.1	28
THALLIUM ACETATE	563688	1.4	36
THALLIUM CARBONATE	6533739	1.26	32
THALLIUM CHLORIDE	7791120	1.26	32
THALLIUM NITRATE	10102451	1.4	36
THALLIUM SELENITE	12039520	1.4	36
THALLIUM SULFATE	7446186	1.26	32
THIOBENCARB	28249776	156	4000
2-(THIOCYANOMETHYLTHIO)-BENZOTHIAZOLE	21564170	460	12200
THIOFANOX	39196184	4.6	122
THIOPHANATE-METHYL	23564058	1260	32000
THIRAM	137268	78	2000
TIN AND COMPOUNDS		9400	200000
TOLUENE	108883	3200	82000
TOLUENE-2,4-DIAMINE	95807	0.2	1.8
TOLUENE-2,5-DIAMINE	95705	9400	200000
TOLUENE-2,6-DIAMINE	823405	3200	82000
P-TOLUIDINE	106490	3.4	30
TOXAPHENE	8001352	0.58	5.2
TRALOMETHRIN	66841256	118	3000
TRIALLATE	2303175	200	5400
TRIASULFURON	82097505	156	4000
1,2,4-TRIBROMOBENZENE	615543	78	2000
TRIBUTYLTIN OXIDE (TBTO)	56359	0.46	12.2
2,4,6-TRICHLOROANILINE HYDROCHLORIDE	33663502	22	200
2,4,6-TRICHLOROANILINE	634935	19	170
1,2,4-TRICHLOROBENZENE	120821	156	4000
1,1,1-TRICHLOROETHANE	71556	540	14400
1,1,2-TRICHLOROETHANE	79005	11	100
TRICHLOROETHYLENE (TCE)	79016	58	520
TRICHLOROFLUOROMETHANE	75694	4600	122000
2,4,5-TRICHLOROPHENOL	95954	1560	40000
2,4,6-TRICHLOROPHENOL	88062	58	520
2,4,5-TRICHLOROPHENOXYACETIC ACID	93765	156	4000
2-(2,4,5-TRICHLOROPHENOXY)PROPIONIC	93721	126	3200

Table 3.3. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS (mg/kg)	
		S-1	S-2
ACID			
1,1,2-TRICHLOROPROPANE	598776	78	2000
1,2,3-TRICHLOROPROPANE	96184	0.091	0.82
1,2,3-TRICHLOROPROPENE	96195	78	2000
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76131	200000	200000
TRIDIPHANE	58138082	46	1220
TRIFLURALIN	1582098	83	740
1,2,4-TRIMETHYLBENZENE	95636	780	20000
1,3,5-TRIMETHYLBENZENE	108678	780	20000
TRIMETHYL PHOSPHATE	512561	17	150
1,3,5-TRINITROBENZENE	99354	0.78	20
TRINITROPHENYLMETHYLNITRAMINE	479458	156	4000
2,4,6-TRINITROTOLUENE	118967	21	190
URANIUM (SOLUBLE SALTS)	7440611	46	1220
VANADIUM	7440622	110	2800
VANADIUM PENTOXIDE	1314621	140	3600
VANADIUM SULFATE	36907423	320	8200
VERNAM	1929777	15.6	400
VINCLOZOLIN	50471448	400	10200
VINYL ACETATE	108054	15600	200000
VINYL CHLORIDE	75014	0.34	3
WARFARIN	81812	4.6	122
M-XYLENE	108323	32000	200000
O-XYLENE	95476	32000	200000
XYLENE (MIXED)	1330207	32000	200000
ZINC	7440666	4600	122000
ZINC PHOSPHIDE	1314847	4.6	122
ZINEB	12122677	780	20000

* The criteria used to determine Method I S-1 and S-2 target concentrations can be found in Appendices 7 and 8.

** Refer to Appendix 2 for description of target concentration determination for Alkanes, Aromatics, Dioxins, Furans and Lead.

Table 3.4. Target Concentrations for Method I S-3:G-1 and S-3:G-2 Soil Categories*

COMPOUNDS	CAS #	METHOD 1 TARGET CONCENTRATIONS (mg/kg)	
		S3:G-1	S3:G-2
ACENAPHTHENE	83329	8.16	
ACENAPHTHYLENE	208968	11.36	
ACETONE	67641	2.81	
ACRYLAMIDE (PROPENAMIDE)	79061	0.00004	
ANTHRACENE	120127	995	
ARSENIC	7440382	26.2	
ATRAZINE	1912249	0.024	
BARIUM	7440393	848	
BENZENE	71432	0.0056	0.0578
BENZO (A) ANTHRACENE	56553	0.343	
BENZO (G,H,I) PERYLENE	191242	6720	
BIS (2-CHLOROETHYL) ETHER	111444		0.599
BIS (2-CHLOROISO-PROPYL) ETHER	396383329		2.165
BORON	7440428	20.48	
BROMODICHLOROMETHANE	75274	0.0029	
BROMOFORM (TRIBROMOMETHANE)	75252	0.00125	
BROMOMETHANE	74839		0.043
BUTYL BENZYL PHTHALATE	85687	27.800	
CADMIUM	7440439	2.72	
CARBOFURAN	1563662	0.258	
CARBON DISULFIDE	75150	4.94	
CARBON TETRACHLORIDE	56235	0.00274	0.00861
CHLORDANE	57749	0.0278	
CHLOROBENZENE	108907	0.438	3.04
CHLOROETHANE	124481	13.6	
CHLOROFORM (TRICHLOROMETHANE)	75003	0.00101	0.0173
CHLOROPHENOL 2-	95578	0.0012	
CHROMIUM	7440473	27.2	
CHRYSENE	218019	38.15	
CIS-1,2-DICHLOROETHENE	156592	0.35	
COPPER	7440508	704	
CYANIDE	57125	31.1	
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE (DEHP)	117817	6.67	
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742	24.8	
DI-N-OCTYL PHTHALATE	117840	233000	
DIBROMO-3-CHLOROPROPANE 1,2-	96128	0.00015	
DICHLOROBENZENE 1,2 (O-DCB)	95501	7.27	79.15
DICHLOROBENZENE 1,3 (M-DCB)	541731	23.7	
DICHLOROBENZENE 1,4 (P-DCB)	106467	1.24	455
DICHLORODIFLUOROMETHANE (FREON-12; HALON)	75718	306	
DICHLOROETHANE 1,1	75343	3.82	46.9
DICHLOROETHANE 1,2 (ETHYLENE DICHLORIDE)	107062	0.00184	

Table 3.4. Continued.

		METHOD 1 TARGET CONCENTRATIONS (mg/kg)	
COMPOUNDS	CAS #	S3:G-1	S3:G-2
DICHLOROETHENE 1,2 (TRANS)	156605	0.380	
DICHLOROETHYLENE 1,1 (VINYLIDENE CHLORIDE)	75354	0.0445	0.00401
DICHLOROPHENOXY ACETIC ACID 2,4 (2,4-D)	94757	0.309	
DICHLOROPROPANE 1,2-	78875	0.00288	0.681
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756	0.0009	0.017
DIETHYLPHTHALATE (DEP)	84662	28.22	
DIOXIN 2,3,7,8-TCDD ONLY	1746016	1.45E-05	
DIPHENYL (BIPHENYL)	92524	8.91	
ENDRIN	72208	0.44	
EPICHLOROHYDRIN (1-CHLORO-2,3-EPOXYPROPANE)	106898	0.0149	
ETHYLBENZENE	100414	0.241	227.371
ETHYLENE DIBROMIDE (EDB, 1,2-DIBROMOETHANE)	106934	1.97E-06	0.002
ETHYLENE GLYCOL	107211	28.002	
FLUORANTHENE	206440	276.080	
FLUORENE	86737	44.297	
FLUORIDE	7782414		
HEPTACHLOR	76448	0.0024	
HEPTACHLOR EPOXIDE	1024573	0.0067	
HEPTANE	142825	558.643	
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741	0.032	
IRON	7439896	151.2	
ISOPROPYL ETHER (DIISOPOROPYL ETHER)	108203	0.373	
LEAD	7439921	270.06	
LINDANE (GAMMA-BHC)	58899	0.006	
MANGANESE	7439965	65.2	
MERCURY	7439976	0.0154	
METHANOL	67561	14.194	
METHOXYCHLOR	72435	56.140	
METHYL ETHYL KETONE (MEK; 2-BUTANONE)	78933	0.692	692
METHYL ISOBUTYL KETONE (MIBK)	108101		220
METHYL TERT-BUTYL ETHER	1634044	0.916	916
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092	0.0221	1.386
N-HEXANE	110543	36.934	
NAPHTHALENE	91203	0.584	
NICKEL	7440020	56.4	
OXAMYL	23135220	0.708	
P-DIOXANE (1,4-DIETHYLENE DIOXIDE)	123911	0.0285	
PENTACHLOROPHENOL	87865	0.0231	
PHENANTHRENE	85018	59.64	
PHENOL	108952	1.746	

Table 3.4. Continued.

COMPOUNDS	CAS #	METHOD 1 TARGET CONCENTRATIONS (mg/kg) S3:G-1	S3:G-2
PYRENE	129000	286.44	
SELENIUM	7782492	12.2	
SILVER	7440224	0.223	
SILVEX (2,4,5-TP)	93721	2.77	
SIMAZINE	122349	0.0237	
STYRENE (ETHENYLBENZENE)	100425	2.242	805.028
TETRACHLOROETHANE 1,1,1,2-	630206		0.034
TETRACHLOROETHANE 1,1,2,2-	79345		0.119
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184	0.0074	4.195
TOLUENE (METHYLBENZENE)	108883	7.275	40.671
TOXAPHENE	8001352	0.0595	
TRICHLOROBENZENE 1,2,4-	120821		354.359
TRICHLOROETHANE 1,1,1 (METHYL CHLOROFORM)	71556	1.668	33.834
TRICHLOROETHANE 1,1,2-	79005		0.1788
TRICHLOROETHYLENE (TCE)	79016	0.0183	0.196
TRICHLOROFLUORO-METHANE	75694	31.4524	
VINYL CHLORIDE (CHLOROETHYLENE)	75014	9.52148E-05	0.000127
XYLENES (O-, M-, AND P-)	1330207	4.958	49.835
ZINC	7440666	1100.4	

* The criteria used to determine Method I S-3:G-1 and S-3:G-2 target concentrations can be found in Appendix 9, Tables 1 and 2.

Table 3.5. Target Concentrations for Method I S-3:G-3 Soil Category*

		METHOD I TARGET CONCENTRATIONS S-3:G-3 (mg/kg)		
COMPOUNDS	CAS #	250 feet	500 feet	1000 feet
ACENAPHTHENE	83329	174	174	174
ANTHRACENE	120127	306	306	306
ARSENIC	7440382	65.5	131	262
BENZENE	71432	1	2.01	4.02
BENZO (A) ANTHRACENE	56553	0.878	1.76	3.51
BENZO (G,H,I) PERYLENE	191242	3.92	4.16	4.16
BIS (2-CHLOROETHYL) ETHER	111444	0.000281	0.000281	0.000281
BORON	7440428	120	240	480
BROMODICHLOROMETHANE	75274	0.6	1.2	2.4
BROMOFORM (TRIBROMOMETHANE)	75252	1.25	1.25	1.25
BROMOMETHANE	74839	181	362	725
CADMIUM	7440439	2.72	5.44	10.9
CARBON TETRACHLORIDE	56235	0.101	0.202	0.403
CHLORDANE	57749	0.00151	0.00303	0.00606
CHLOROBENZENE	108907	438	438	438
CHLOROETHANE	124481	0.413	0.825	1.65
CHRYSENE	218019	0.976	1.95	3.9
COPPER	7440508	5.28	10.6	21.1
CYANIDE	57125	0.505	1.01	2.02
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE (DEHP)	117817	32.9	65.8	132
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742	1060	2120	4250
DICHLOROBENZENE 1,2 (O-DCB)	95501	498	850	850
DICHLOROBENZENE 1,3 (M-DCB)	541731	248	496	993
DICHLOROETHANE 1,2 (ETHYLENE DICHLORIDE)	107062	1.2	1.84	1.84
DICHLOROETHYLENE 1,1 (VINYLIDENE CHLORIDE)	75354	0.0509	0.102	0.203
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756	0.91	0.91	0.91
DIETHYLPHTHALATE (DEP)	84662	1690	3390	6770
DIOXIN 2,3,7,8-TCDD ONLY	1746016	0.00231	0.00462	0.00924
ENDRIN	72208	0.0011	0.0022	0.0044
ETHYLBENZENE	100414	241	241	241
FLUORANTHENE	206440	131	131	131
FLUORENE	86737	150	150	150
HEPTACHLOR	76448	0.00016	0.000321	0.000642
HEPTACHLOR EPOXIDE	1024573	0.000459	0.000917	0.00183
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741	0.00309	0.00618	0.0124
IRON	7439896	1260	2520	5040
LEAD	7439921	1130	2250	4500
LINDANE (GAMMA-BHC)	58899	0.00031	0.00062	0.00124
MANGANESE	7439965	326	652	1300
MERCURY	7439976	0.00042	0.000841	0.00168
METHOXYCHLOR	72435	0.12	0.241	0.481

Table 3.5. Continued.

COMPOUNDS	CAS #	METHOD I TARGET CONCENTRATIONS S-3:G-3 (mg/kg) 250 feet	500 feet	1000 feet
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092	17.7	22.1	22.1
NICKEL	7440020	11.7	23.4	46.8
PYRENE	129000	109	109	109
SELENIUM	7782492	3.05	6.1	12.2
SILVER	7440224	0.00186	0.00372	0.00744
SILVEX (2,4,5-TP)	93721	0.0000817	0.000163	0.000327
TETRACHLOROETHANE 1,1,2,2-	79345	0.151	0.303	0.606
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184	0.235	0.469	0.939
TOLUENE (METHYLBENZENE)	108883	0.2	0.4	0.8
TOXAPHENE	8001352	0.00096	0.00192	0.00384
TRICHLOROETHANE 1,1,2-	79005	0.584	1.17	2.34
TRICHLOROETHYLENE (TCE)	79016	1.51	3.02	6.04
VINYL CHLORIDE (CHLOROETHYLENE)	75014	0.0952	0.0952	0.0952
ZINC	7440666	65.5	131	262

* The criteria used to determine Method I S-3:G-1 and S-3:G-2 target concentrations can be found in Appendix 9, Table 3.

CHAPTER 4 - DATA COLLECTION REQUIREMENTS

A. Introduction

This chapter discusses the types and quality of site data needed to support the determination of target concentrations (Methods I, II and III) and use of site-specific risk assessment presented in Chapters 2 and 3. In general, the data collected should be sufficient to:

- characterize the source, nature, distribution and extent of the spill or release;
- determine the migration pathways for the released substance; and
- identify and characterize all potential human, animal and environmental receptors that could be affected by the spill or release at or migrating from the site.

B. Types of Data

The types of site data generally required for Methods I, II and III include:

- location and characteristics of all source areas;
- contaminant identities;
- concentrations of contaminants in each source area and potential media of concern; and
- characteristics of the environmental setting that may affect contaminant fate and transport (the movement and persistence of contaminants in the environment).

Most of these data are obtained during investigation and characterization of the contaminated site and surrounding environment. For Methods II and III and site-specific risk assessments, additional data may be needed to determine background levels; further evaluate the movement and persistence of contaminants; and estimate the current and potential exposure of humans, animals and the environment to these contaminants.

These data may include:

- background samples;
- physical and chemical parameters for modeling contaminant fate and transport;
- a detailed survey of receptors; and

- an evaluation of the current and potential uses of the site and surrounding environment.

Ideally, a risk assessor should assist in planning site investigation and characterization activities to ensure that appropriate data are obtained. Specific data and information to be collected for use in this framework are listed in Appendix 11.

It should be noted that each regulatory program within DEHNR has its own requirements for site assessment. The site data requirements in this document apply only to this framework. Therefore, the responsible party must refer to the specific program requirements for site assessment to ensure full compliance with the requirements of the agency having regulatory authority over the site.

Site characterization requirements for the DEHNR regulatory programs should be in accordance with:

Division of Waste Management, Superfund Section, Inactive Hazardous Sites Program - *Guidelines for Responsible Party Site Remedial Action.*

Division of Waste Management, RCRA Section - Requires vertical and horizontal extent of contaminant plume to be verified for each unit at a facility in accordance with SW846 and 40 CFR 265.

- *RCRA Facility Investigation (RFI) Guidance.* EPA 530/SW-89-031.
- *RCRA Ground Water Monitoring Draft Technical Guidance.* EPA 530-R-93-001.
- *RCRA Ground Water Monitoring Technical Enforcement Guidance Document.*

Division of Waste Management, Solid Waste Section - Subtitle D facility requirements for site assessment and corrective action must be in accordance with 15A NCAC 13B .1600.

Division of Water Quality, Groundwater Section - *Groundwater Section Guidelines for the Investigation and Remediation of Soils and Groundwater*. March 1993 (with June 1993 Revisions incorporated).

C. Data Collection

This section discusses important data collection and evaluation considerations, but is not intended to provide complete procedures for collecting and evaluating data or designing sampling plans. For specific data collection guidance, the responsible party must refer to the appropriate regulatory program requirements. More detailed guidance may also be found in Risk Assessment Guidance for Superfund, Volume I, Human Health Manual (Part A) (EPA 1989).

Modeling Data

Because site monitoring data are often insufficient to predict the distance and rate of contaminant movement, it may be necessary to use contaminant fate and transport models to estimate exposure concentrations. Therefore, it may be advantageous to make a preliminary assessment of the models that may be used in Methods II or III and incorporate those data requirements into the data collection plan. This action will ensure that the data necessary for model calibration and validation are collected along with other physical and chemical data at the site. Appendix 10 describes the groundwater modeling guidelines for determining groundwater transport away from a contaminated site. Figure 3.12 in Chapter 3 presents the minimum documentation requirements for modeling transport of soil contaminants to groundwater and groundwater contaminants to indoor air.

Background Sampling

It may be necessary to conduct background sampling (sampling of an up-gradient or uncontaminated portion of the site) to distinguish site-related contamination at the site from naturally occurring or other non-site related concentrations of chemicals. There are two types of background levels of chemicals:

(a) naturally occurring levels - concentrations of chemicals (e.g., aluminum, manganese) attributable to natural sources that are consistently present in the environment at and in the vicinity of the site

(b) anthropogenic levels - concentrations of chemicals (e.g., PAHs, lead) due to human-made, non-site sources (e.g., industry, automobiles) that are consistently present in the environment at and in the vicinity of the site.

Clean-up may not be required for chemicals present at levels consistent with natural background concentrations, nor for those levels consistent with anthropogenic background concentrations. However, this determination will be made on a site-specific basis and only with the approval of the Department.

When comparing site concentrations to background levels, sampling to characterize background conditions is needed. The analytical methods and background sample collection methods should be consistent with those for the other site-related samples. In addition, the background samples should be handled, stored and transported in the same fashion as the site-related samples.

Ideally, the background samples should be collected concurrently with the site-related samples. This is most important for media (e.g., groundwater, air and surface water) where the concentrations may vary over time. A sufficient number of samples should be collected to compare site concentrations to background levels.

Background samples should be collected from areas that appear undisturbed and unstained; are unlikely to have been used for handling, storing or disposing of contamination; and are unlikely to have been affected by the migration of these substances. Background locations should be selected carefully based on all prior knowledge of site conditions and history of use. The sample locations should be based on the similarity of medium and environmental conditions at the background area and the release site. Background areas may be selected through review of existing historical records, consideration of the current environmental setting along with physical observations and field screening data. The Department requires submission of supporting evidence that the areas sampled are representative of background conditions.

For more guidance on background sampling, see EPA's Supplemental Guidance to RAGS (EPA 1995a).

Sampling Strategy

Prior to designing a sampling plan for the site, the responsible party should determine current and past uses of the site and potential locations of possible environmental contamination. This activity involves identifying: the contaminated media, potentially affected areas, types of contaminants expected to be present, and the potential migration pathways.

Media

Samples must be collected from each medium in such a way that all exposures may be evaluated.

Areas

Samples should be collected from all areas at and near the site that:

- contain or are expected to contain different types of chemicals;
- are release source areas;
- contain different (lower or higher) expected concentrations or are hot spots;
- are different from other areas based on spatial or temporal considerations; or
- must be sampled using different sampling equipment.

Such areas may also include the locations of human, fish or wildlife populations potentially exposed.

Types of Contaminants

The physical and chemical properties of contaminants (and their degradation products) expected to be present at the site are important to consider when designing a sampling plan. For example, contaminants (e.g., dioxin) that may bioaccumulate in aquatic life are also likely to be present in sediments. Therefore, it would be very important to sample the sediments and aquatic life for these contaminants.

Pathways of Contaminant Transport

The ways contaminants move within or between media should be considered when determining the media and locations to be sampled. For example, if surface water runoff from an affected area is discharged via a ditch or sewer to a surface water body, it would be important to sample water and sediment in the ditch or sewer as well as water from the surface water. Tidally influenced areas may also require special sampling to ensure that tidal effects are considered.

Numbers of Samples

The number of samples collected at a site will depend on the number, size and nature of the contaminated areas; the statistical methods that are planned; seasonal or meteorological elements that may affect the media; logistics and cost. Generally, the number of samples should be sufficient to characterize the source, nature and extent of the release, and to obtain an understanding of the distribution of contaminant concentrations within an area.

Analytical Methods

Analytical data sets appropriate for use in this framework, are those that have been developed according to a standard set of sensitive chemical-specific methods with quality assurance/quality control (QA/QC) procedures that are well-documented and traceable. Examples of such methods include SW846 methods and EPA 500 and 600 series methods. Analytical results are inappropriate for use in this framework if they are not chemical-specific or result from insensitive analytical methods (e.g., analyses from portable field instruments such as an organic vapor analyzer and other field screening instruments) or methods with unknown, few or no QA/QC procedures.

It is recommended that during an initial phase of data collection, samples be analyzed for a full scan of chemicals to ensure that all chemicals which may be present at the site are identified. EPA Region IV risk assessment personnel (personal communication) recommend that in subsequent phases of data collection, 20 percent of the samples collected should be analyzed for a full scan of parameters and the remainder analyzed for only those chemicals previously identified.

For evaluating petroleum contamination in soil, two to three samples from each affected area should be analyzed for specific alkane (C5-C8, C9-C18 and C19-C32) and aromatic (C9-C32) carbon fractions using a gas chromatograph and flame ionization/photo ionization detector. These samples should be collected from soil with the highest expected contaminant concentrations. Carbon fraction analysis would be in addition to performing appropriate analytical scans for specific chemicals (e.g., benzene, pyrene).

Evaluation

Data evaluation involves organizing the site data into a form that can be used for target concentration determination or site-specific risk assessment. This process includes the following steps:

- organize the analytical data by medium;
- evaluate the quality of the data using appropriate quantitation limits;
- evaluate the quality of the data with respect to data qualifiers and codes;
- evaluate the data with respect to blanks;
- evaluate any tentatively identified compounds;
- compare potential site-related contamination with background levels;
- compile data set; and
- further limit the number of chemicals to be used in the target concentration determination or site-specific risk assessment, if appropriate, and after consultation with the Department.

Detailed guidance for data evaluation may be found in Risk Assessment Guidance for Superfund, Volume I, Human Health Manual (Part A) (EPA 1989).

Identification and Characterization of Potential Human and Environmental Receptors

Data collection should include the identification and characterization of the potentially exposed persons who live, work, play, visit, or otherwise come to the site and surrounding environment. The responsible party must also consider those who may come in contact with the site in the future, if the use of the site were to change.

The environmental receptor survey should describe the potentially exposed species of concern, threatened species or endangered species, known or likely to be located at the site or in the surrounding environment. The survey also should identify any critical habitats or sensitive environmental areas.

Identification of Current and Reasonably Foreseeable Site Activities and Uses

The uses of a site and the surrounding area determine the activities that occur there and the potential for exposures by human and environmental receptors to a released substance. Therefore, to adequately evaluate potential exposures, the responsible party must identify and describe the current and reasonably foreseeable activities and uses associated with the site and the surrounding environment.

D. Documentation Requirements

The responsible party must submit documentation of the risk evaluation. The minimum documentation that must be provided is listed below.

METHOD I

- Worksheets and tables provided in Appendix 1 and
- Information in Appendix 11 including Sections 1, 2, 3, 4, 5 and 8. (Site assessment reports containing the Appendix 11 information may be appended to the submission.)

METHODS II and III

- Worksheets and tables provided in Appendix 1;
- Detailed description of all assumptions, toxicity values, equations, models (Method III only) and references used; and
- Information in Appendix 11 including Sections 1, 2, 3, 4, 5 and 8 and if appropriate, Sections 6 and 7. Site assessment reports containing the Appendix 11 information may be appended to the submission.

SITE-SPECIFIC RISK ASSESSMENT

- Risk assessment report documenting all existing or foreseeable exposure scenarios and pathways which include human and ecological receptors, potential and current source(s) of contaminants, transport medium or media, points of potential human contact, and exposure routes. Detailed description of all assumptions, toxicity values, evaluations, models, uncertainty estimations and references used. Parties which meet EPA's RAGS (EPA 1989) requirements for risk assessments and any subsequent national and regional guidance will have met the minimum requirements.
- All information in Appendix 11. Site assessment reports containing this information may be appended to the risk assessment report.

METHODS I, II and III and SITE-SPECIFIC RISK ASSESSMENT

- Distance to and likelihood of impact to public or private drinking and non-drinking water wells;
- Current availability of public water supply. This information should include type of supply, location and distance from site;
- Distance from contaminated groundwater to soil surface and to existing buildings nearby. Preferential pathways for contaminant migration such as underground utility lines should also be described;

- Distance to and likelihood of impact to surface water;
- Current and reasonably foreseeable use of the site and surrounding environment; and
- Distance to nearest residential areas.

The appropriate regulatory agency may have additional documentation requirements and must be consulted prior to beginning Method I, II and III target concentration determinations or a site-specific risk assessment.

CHAPTER 5 - REFERENCES

American Society for Testing and Materials (ASTM). 1995. *Risk - Based Corrective Action Applied at Petroleum Releases Sites*. Designation E 1739-95.

Environmental Protection Agency (EPA). 1989. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002.

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Massachusetts Department of Environmental Protection (MDEP). 1994. *Background Documentation for the Development of the MCP Numerical Standards.* Bureau of Waste Site Clean-up and Office of Research and Standards.

Pollution Prevention Advisory Council (PPAC). 1994. *Pollution Prevention Advisory Council Final Report, October 1994.*

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As the risk analysis framework developed, we received professional support from a number of sources telling us the efforts were worth it. These individuals contributed their time and support to our efforts, and there is no doubt that the risk analysis framework continues to strengthen as a direct result of their efforts.

The risk analysis framework will continue to improve with implementation and use. The continued insight and support of those who have assisted us to date, and those who will assist us in the future, will contribute to the safe and effective management of North Carolina's environment.

RISK-BASED PROTOCOL WORKING GROUP

Division of Air Quality	Beth Mileson	
Division of Epidemiology	Bill Pate Luanne Williams, Co-Chair	
Division of Waste Management	Hanna Assefa Sharron Rogers	
Division of Water Quality	Carl Bailey Linda Blalock David Hance Randy Prillaman	Dianne Reid Ruth Strauss, Chair Lisa Taber

APPENDIX 1:
WORKSHEETS FOR DERIVATION OF METHODS I, II AND III GROUNDWATER AND SOIL TARGET CONCENTRATIONS

WORKSHEET A1.1. SELECTION OF GROUNDWATER CATEGORIES (G-1, G-2 & G-3) AND CALCULATION OF TARGET CONCENTRATIONS FOR METHODS I, II & III FOR EACH CONTAMINANT AT A SITE.

1) Is groundwater current or potential drinking water?

YES Enter G-1 at line A and go to 2 ....A _____

NO Go to 2.

2) Does exposure to contaminated groundwater occur through activities such as swimming in a swimming pool, gardening, irrigation, etc.?

YES Enter G-1 at line B and go to 3 ....B _____

NO Go to 3.

3) Is contaminated groundwater at a vertical depth of 15 feet or less from soil surface or building substructure, and, within 30 horizontal feet or less of either an existing building, or a preferential pathway to a building?

YES Enter G-2 at line C and go to 4 ....C _____

NO Go to 4

4) Is there current or potential movement of groundwater contaminants to surface water?

YES Enter G-3 at line D and go to 5 ....D _____

NO Provide documentation that demonstrates no impact to surface water body will occur. Go to 5.

5) Is your site in the G-1, G-2 or G-3 category? See lines 1A, 2B, 3C and 4D above.

YES Go to 6

NO Go to 16.

6) Enter groundwater contaminants found at site into Column I of Table A1.1. Go to 7.

7) Enter maximum groundwater levels detected at site into Column II of Table A1.1 and go to 8.

8) *(Begin with the first contaminant and work through the following steps for each contaminant in Table A1.1 until all have been through the process.)*

Is your site in the G-1 Category? See lines 1A and 2B above. If G-1 is entered on either line, then site is in G-1 Category.

- YES Is there a Method I G-1 Target Concentration in Table 3.1?
  - YES Is clean-up to the Method I G-1 Target Concentration feasible?
    - YES Enter Method I G-1 Target Concentration from Table 3.1 with a (I) beside it to indicate that Method I was used to determine this level into Column III of Table A1.1. Go to 10.
    - NO Use Method II to determine the groundwater Target Concentration (Chapter 3, Procedure for Determining Method II G-1 Target Concentrations). Go to 9.
  - NO Use Method II to determine the groundwater Target Concentration (Chapter 3, Procedure for Determining Method II G-1 Target Concentrations). Go to 9.
- NO Go to 10.

9) Is clean-up to Method II G-1 Target Concentration feasible?

- YES Enter the calculated Target Concentration into Column III of Table A1.1 with (II) beside it to indicate that Method II was used in determining this concentration. Go to 10.
- NO Submit a request for approval to the Director or his designee to approve termination of corrective action according to 15A NCAC 2L .0104 and .0106(n). Go to 10.

10) Is your site in the G-2 Category? See line 3C above.

- YES Is there a Method I G-2 Target Concentration in Table 3.1?
  - YES Is clean-up to Method I G-2 Target Concentration feasible?
    - YES Enter Method I G-2 Target Concentration with a (I) beside it into Column IV and go to 13.
    - NO Use Method II G-2 to determine the Target Concentration (Chapter 3, Procedure for Determining Method II G-2 Target Concentrations) Go to 11.
  - NO Use Method II G-2 to determine the Target Concentration (Chapter 3 Procedure for Determining Method II G-2 Target Concentrations) Go to 11.
- NO Go to 13.

11) Is clean-up to Method II Target Concentration feasible?

- YES Enter Target Concentration into Column IV with (II) beside it to indicate that Method II was used in determining this concentration. Go to 13.

NO Use Method III G-2 to determine the Target Concentration (Chapter 3, Method III Target Concentration Determination) replacing default transport model with more site-specific model. Go to 12.

12) Is clean-up to Method III Target Concentration feasible?

YES Enter Target Concentration into Column IV with (III) beside it to indicate that Method III was used in determining this concentration. Go to 13.

NO Submit a request for approval to the Director or his designee to conduct a site specific risk assessment. If approval is granted this worksheet may not be used.

13) Is your site in the G-3 Category? See line 4D above.

YES Does your site meet the following criteria:

- Groundwater plume is NOT in fractured bedrock;
- Groundwater plume's leading edge is greater than 250 feet from the surface water body;
- Groundwater plume length is less than 100 feet;
- Potentially impacted surface water is NOT classified as trout waters or water supplies (WS-I through WS-V) or future water supply (FWS); or
- Groundwater saturated thickness above bedrock is greater than 15 feet?

YES Is there a Method I G-3 Target Concentration in Table 3.2?

YES Is clean-up to Method I G-3 Target Concentration feasible?

YES Enter Method I G-3 Target Concentration with a (I) beside it into Column V and go to 17.

NO Use Method II G-3 to determine the Target Concentration (Chapter 3, Procedure for Determining Method II G-3 Target Concentrations) Go to 14.

NO Use Method II G-3 to determine the Target Concentration (Chapter 3 Procedure for Determining Method II G-3 Target Concentrations) Go to 14.

NO Use Method II G-3 to determine the Target Concentration (Chapter 3 Procedure for Determining Method II G-3 Target Concentrations) Go to 14.

NO Go to 17.

14) Is clean-up to Method II Target Concentration feasible?

YES Enter Target Concentration into Column V with (II) beside it to indicate that Method II was used in determining this concentration. Go to 17.

NO Use Method III G-3 to determine the Target Concentration (Chapter 3, Method III Target Concentration Determination) replacing default transport model with more site-specific model. Go to 15.

15) Is clean-up to Method III Target Concentration feasible?

YES Enter Target Concentration into Column V with (III) beside it to indicate that Method III was used in determining this concentration. Go to 17.

NO Submit a request for approval to the Director or his designee to conduct a site specific risk assessment. If approval is granted this worksheet may not be used.

16) Enter the lower of the following two parameters:

- 1000 times the groundwater quality standard (or interim standard) for the contaminant or
- 50% of the solubility of the contaminant

into Column VI and put "CCL" in Column VII. Go to 17.

17) Was this the last contaminant in Column I of Table A1.1?

YES Go to 18.

NO Is site is in G-1, G-2 or G-3 categories?

YES Go to 8 and continue to work through process until all contaminants have Target Concentrations.

NO Go to 16 and continue to work through process until all contaminants have Target Concentrations.

18) Compare the Target Concentrations listed in Columns III, IV and V.

Take the lowest of the Target Concentrations for each contaminant from those columns and enter this concentration into Column VI to obtain the required groundwater Target Concentration. Enter groundwater category and method symbol into Column VII. Go to 19.

19) Compare the Target Concentrations in Column VI to the maximum groundwater levels detected in Column II to determine if clean-up for a particular contaminant is necessary.

Highlight the contaminants in Column I whose maximum groundwater levels are above the Target Concentrations from Column VI. The highlighted contaminants must be remediated.

TABLE A1.1. WORK TABLE FOR DETERMINING GROUNDWATER TARGET CONCENTRATIONS.

See Worksheet A1.1 For Instructions On Completing This Work Table.

DATE:
SITE:
COUNTY:
MAILING ADDRESS:

INCIDENT NUMBER: ____________
RESPONSIBLE PARTY: ____________
PHONE NUMBER: ____________
____
____
____
____
____

All concentrations are in mg/L.

I	II	III	IV	V	VI	VII
Contaminants Found in Groundwater	Maximum Groundwater Concentration at Site	Target Concentrations by Groundwater Category			Required Groundwater Target Concentration*	Groundwater Category and Method
		G-1	G-2	G-3		

* Lowest of the three target concentrations in Columns III through V unless none of the categories applied. If none of the categories apply, then enter the concentration for CCL where: CCL = the lower of 1000 times Groundwater quality standard (or interim groundwater quality standard) and 50% of the aqueous solubility of the contaminant.

WORKSHEET A1.2. SELECTION OF SOIL CATEGORIES (S-1, S-2, OR S-3) AND CALCULATION OF TARGET CONCENTRATIONS FOR METHODS I, II & III FOR EACH CONTAMINANT AT A SITE.

1) Is the soil at the area of concern at the site located in a residential, recreational, day care or other area where current or future exposure to contaminated soil may occur via playing, gardening, etc.?

Yes Enter S-1 at line A and go to 3 ....A _____

NO Go to 2.

2) Is the soil at the area of concern at the site located in an industrial or commercial area where exposure to contaminated soil may occur?

YES Enter S-2 at line B and go to 3 ....B _____

NO Go to 3

3) Is your site in the G-1, G-2, or G-3 category? See lines 1A, 2B, 3C and 4D in Worksheet A1.1.

YES Enter S-3 at line C and go to 4 ....C _____

NO Go to 4.

4) Go to Table A1.2 (Work Table for Determining Soil Target Concentrations). Enter contaminants found in the soil at the site in Column I. Go to 5.

5) Enter maximum soil levels detected at site in Column II of Table A1.2. Go to 6.

6) *Begin with the first contaminant in Column I and work through the following 6 steps for each contaminant in Table A1.2 until required Target Concentrations have been determined for all contaminants.*

Is the contaminant found in the groundwater and soil?

YES Enter an (Y) into Column III of Table A1.2.

Enter the groundwater Target Concentration from Column VI of Table A1.1 into Column IV of Table A1.2.

Enter the corresponding Groundwater Category and Method symbol from Column VII of Table A1.1 into Column V of Table A1.2. Go to 7.

NO For contaminants found in soil only, enter the contaminant in Column I of Table A1.3.

Table A1.3 must be completed to obtain the acceptable groundwater concentrations for use in Column IV of Table A1.2.

To complete Table A1.3, follow the directions from Worksheet A1.1 (excluding steps 5 and 6), entering the information into the columns in Table A1.3 instead of Table A1.2.

Enter the acceptable groundwater level from Column VI of Table A1.3 into Column IV of Table A1.2.

Enter the corresponding Groundwater Category and Method symbol from Column VII of Table A1.3 into Column V of Table A1.2. Go to 7.

7) Is the area of concern at the site in the S-1 Category? See line 1A above.

- YES Is there a Method I S-1 Target Concentration in Table 3.3?
  - YES Is clean-up to Method I S-1 Target Concentration feasible?
    - YES Enter Method I S-1 Target Concentration from Table 3.3 into Column VI of Table A1.2 with a (I) beside it to indicate Method I was used. Go to 11.
    - NO Use Method II to determine the soil Target Concentration (Chapter 3, Procedure for Determining Method II S-1 Target Concentrations). Go to 8.
  - NO Use Method II to determine the soil Target Concentration (Chapter 3, Procedure for Determining Method II S-1 Target Concentrations). Go to 8.
- NO Go to 9.

8) Is clean-up to Method II S-1 Target Concentration feasible?

- YES Enter the Target Concentration into Column VI of Table A1.2 with (II) beside it to indicate that Method II was used to determine this Concentration and go to 11.
- NO Submit a request for approval to the Director or his designee to conduct a site specific risk assessment. If approval is granted this worksheet may not be used.

9) Is the site in the S-2 Category? See line 2B above.

- YES Is there a Method I S-2 Target Concentration in Table 3.3?
  - YES Is clean-up to Method I S-2 Target Concentrations feasible?
    - YES Enter Method I S-2 Target Concentration into Column VII of Table A1.2 with a (I) beside it to indicate Method I was used. Go to 11.
    - NO Use Method II to determine the soil Target Concentration (Chapter 3, Procedure for Determining Method II Target Concentrations). Go to 10.
  - NO Use Method II to determine the soil Target Concentration (Chapter 3, Procedure for Determining Method II Target Concentrations). Go to 10.
- NO Go to 11.

10) Is clean-up to Method II S-2 Target Concentration feasible?

- Yes Enter the Target Concentration into Column VII of Table A1.2 with (II) beside it to indicate that Method II was used to determine this concentration and go to 11.
- NO Submit a request for approval to the Director or his designee to conduct a site specific risk assessment. If approval is granted this worksheet may not be used.

11) Is the site in the S-3 category (transport of contaminant from soil-to-groundwater)?

- YES Using Column V determine appropriate S-3 Category based on the Groundwater Category (S-3:G-1, S-2:G-2 or S-3:G-3).

  Is there a Target Concentration available in Chapter 3, Tables 3.4 and 3.5 under the appropriate S-3 Category for this contaminant?

  - YES Is clean-up to this Method I S-3 Target Concentration feasible?
    - YES Enter Method I S-3 Target Concentration into Column VIII of Table A1.2 with a (I) beside it to indicate that Method I was used. Go to 13.
    - NO Use Method II to determine the S-3:G-1, S-3:G-2 or S-3:G-3 Target Concentration (Chapter 3, Procedure for Determining Method II S-3 Soil Target Concentration). Go to 12.
  - NO Use Method II to determine the appropriate S-3:G-1, S-3:G-2 or S-3:G-3 Target Concentration (Chapter 3, Procedure for Determining Method II S-3 Soil Target Concentration). Go to 12.
- NO Go to 13.

12) Is clean-up to Method II S-3 Target Concentration feasible?

- Yes Enter the Target Concentration into Column VIII of Table A1.2 with a (II) beside it to indicate that Method II was used to determine this concentration and go to 13.
- NO Submit a request for approval to the Director or his designee to conduct a site specific risk assessment. If approval is granted this worksheet may not be used.

13) Was this the last contaminant in Column I of Table A1.2?

- YES Go to 14.
- NO Go to 6 and continue to work through the worksheet until all contaminants have Target Concentrations.

14) Compare the Target Concentrations listed in Columns VI, VII and VIII of Table A1.2.

Take the lowest of the Target Concentrations from those columns and enter in Column IX of Table A1.2 as the Required Soil Target Concentration.

Enter the soil category and method symbol for the Required Soil Target Concentration into Column X. For S-3 Category enter as S-3:G-1, S-3:G-2 or S-3:G-3. Go to 15.

15) Compare the Required Soil Target Concentrations in Column IX to the maximum soil levels detected in Column II to determine if clean-up for a particular contaminant is necessary.

Highlight the contaminants in Column I of Table A1.2 whose maximum soil levels are above the required Target Concentrations from Column IX. These contaminants must be remediated.

TABLE A1.2. WORK TABLE FOR DETERMINING SOIL TARGET CONCENTRATIONS.

See Worksheet A1.2 For Instructions On Completing This Work Table.

DATE:

INCIDENT NUMBER: __________

SITE:

RESPONSIBLE PARTY: __________

COUNTY:

PHONE NUMBER: __________

MAILING ADDRESS: __________

I	II	III	IV	V	VI	VII	VIII	IX	X
Contaminants in Soil	Maximum Soil Concentration at Site (mg/kg)	Is the Contaminant in Groundwater & Soil (Y=YES)	Groundwater Target Concentration (mg/L)	Groundwater Category & Method	Soil Target Concentrations by Soil Category (mg/kg)			Required Soil Target Concentration* (mg/kg)	Soil Category & Method
					S-1	S-2	S-3		

* Lowest concentration from Columns VI, VII, and VIII.

TABLE A1.3 WORK TABLE FOR DETERMINING GROUNDWATER TARGET CONCENTRATIONS FOR CONTAMINANTS FOUND ONLY IN SOIL.

See Worksheet A1.2 for instructions on completing this work table.

DATE:
INCIDENT NUMBER: ____________
SITE:
RESPONSIBLE PARTY: ____________
COUNTY:
PHONE NUMBER: ____________
MAILING ADDRESS: ____________

____

____

____

____

This worksheet is only for contaminants that were not found in the groundwater. It is intended to provide the acceptable groundwater concentrations to be used in determining the S3 target concentrations. All concentrations are in mg/L.

I	II	III	IV	V	VI	VII
Contaminants In Soil ONLY	Maximum Groundwater Concentration at Site	Acceptable Groundwater Concentrations by Groundwater Category			Acceptable Groundwater Concentration*	Groundwater Category and Method
		G-1	G-2	G-3		
	NA					
	NA					
	NA					
	NA					
	NA					
	NA					
	NA					
	NA					
	NA					

* Lowest of the three target concentrations in Columns III through V.

APPENDIX 2. DEFAULTS AND ASSUMPTIONS

Assumptions And Defaults Used in Methods I and II

In deriving target concentrations in Method I, certain assumptions and defaults were used. Similar assumptions and defaults may be used for Method II. The following section discusses the basis for the various assumptions and defaults used by the Department.

Carcinogens and Noncarcinogens

The derivation of Target Concentrations for categories G-1, G-2, S-1, and S-2 includes the calculation of non-cancer and cancer risk-based concentrations. Both concentrations are calculated because the non-cancer effects of some contaminants may occur at concentrations below the cancer risk-based concentrations.

A hazard quotient of 0.2 was selected for deriving non-cancer risk-based concentrations for all contaminants. Using a hazard quotient of 0.2 to derive a target concentration for a particular contaminant conservatively assumes that there are four other contaminants present at the site that share the same critical health effect (or affect the same organ). This assumption is conservative because it is highly unlikely that more than five contaminants with the same critical effect will occur at a single site.

The excess lifetime cancer risk was set equal to one-in-one million (1×10^{-6}) for each contaminant with the carcinogenic classification of A (human carcinogen) and B1/B2 (probable human carcinogen), and C (possible human carcinogen) to be consistent with the current cancer risk used in calculating groundwater and surface water quality standards. Chemicals with EPA carcinogenic classifications of D or E are considered to be non-carcinogenic. The lowest of the non-cancer and cancer risk-based concentrations is carried through the process for each contaminant to develop the required Target Concentration.

Chlorinated Dioxins and Furans

In order to address the risks associated with complex mixtures of chlorinated dioxins (CDD) and furans (CDF) at contaminated sites, the Department requires the use of toxicity equivalency factors (TEF) for use in soil and groundwater. The TEFs presented in Table A2.1 for each dioxin and furan expresses the relative potency to 2,3,7,8-

tetrachlorodibenzodioxin (TCDD). These TEFs are recommended by the EPA for use with dioxin-like compounds (EPA 1995). The dioxin and furan congener soil target concentrations listed in Table 3.3 were calculated by dividing the target concentration for 2,3,7,8-TCDD by the appropriate TEF.

Table A2.1. Toxicity Equivalents Factors (TEF) for CDDs and CDFs

Dioxin Compound	TEF	Furan Compound	TEF
2,3,7,8-TCDD	1	2,3,7,8-TCDF	0.1
2,3,7,8-PeCDD	0.5	1,2,3,7,8-PeCDF	0.05*
2,3,7,8-HxCDD	0.1	2,3,4,7,8-PeCDF	0.5*
2,3,7,8-HpCDD	0.01	2,3,7,8-HxCDF	0.1
OCDD	0.001	2,3,7,8-HpCDF	0.01
Other CDDs	0	OCDF	0.001
		Other CDFs	0

Source: EPA 1995.

* Correction to EPA 1995 per telephone conversation with EPA Region IV, November 27, 1996.

Carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs)

As with dioxins and furans, TEFs are used for addressing the risk associated with complex mixtures of carcinogenic polynuclear aromatic hydrocarbons (PAHs) in soil and groundwater (Table A2.2). The soil target concentrations for the carcinogenic PAHs listed in Table 3.3 were calculated by dividing the target concentration for benzo(a)pyrene by the appropriate TEF.

Table A2.2. Toxicity Equivalents Factors (TEF) for Carcinogenic PAHs.

Compound	TEF	Compound	TEF
Benzo(a)pyrene	1	Chrysene	0.001
Benzo(a)anthracene	0.1	Dibenzo(a,h)anthracene	1.0
Benzo(b)fluoranthene	0.1	Indeno(1,2,3-cd)pyrene	0.1
Benzo(k)fluoranthene	0.01		

Source: EPA 1995.

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) represent a mixture of a large number of hydrocarbon compounds generally found in petroleum products. These constituents vary depending upon the substance spilled or deposited in the soil or groundwater and, also, upon the changes resulting from degradation and other physical and chemical processes. Due to the difficulty associated with measuring all the hydrocarbon compounds present at a typical site and the uncertainty associated with the toxicology of hydrocarbons, EPA and a variety of interested parties have been working to develop surrogate compounds for specific carbon fraction classes which can be used to determine appropriate target concentrations and to conduct site-specific risk assessments (EPA 1995). Surrogates are used in the framework to determine target concentrations for Alkanes (C5-C8, C9-C18, and C19-C32) and Aromatics (C9-C32). Four surrogates were selected based upon their fate and transport potential and the availability of analytical methods and toxicity values for each of them (Table A2.3).

The EPA toxicity values (Table A6.3) for each surrogate were used as the RfD_o in Equation 1 of Figures 3.7 and 3.9 for soil categories S-1 and S-2. The soil target concentrations for the individual alkane and aromatic classes are listed in Table 3.3.

Table A2.3. Surrogates for Total Petroleum Hydrocarbons.

CLASS	SURROGATE	TOXICITY VALUE (mg/kg-day)
ALKANES		
C5-C8	n-Hexane	0.06
C9-C18	n-Nonane	0.6
C19-C32	Eicosane	6.0
AROMATICS		
C9-C32	Pyrene	0.03

Source: EPA 1995.

Lead

The recommended health-protective concentration for lead in the soil is 400 mg/kg. This concentration is based upon the EPA guidance for CERCLA and RCRA sites (EPA 1995) and is listed in Table 3.3.

Odor Threshold Concentrations

The potential for odor problems is a relevant public welfare issue at contaminated sites. Odor thresholds were considered in determining target concentrations for categories G-1 (drinking exposure scenario), and G-2 (volatilization from groundwater-to-indoor air exposure scenario). The recommended odor threshold concentrations are concentrations at which 50% of the population can detect a compound's odor. This concentration is the standard currently used by state and federal regulatory agencies.

Solubility

The aqueous solubility of a contaminant is used to determine target concentrations for categories G-2 (volatilization from groundwater-to-indoor air exposure scenario) and G-3 (migration of contaminants from groundwater-to-surface water scenario). From a practical aspect, solubility is a concern if the calculated allowable level (based upon risk) is higher than could be expected in the groundwater based upon the material's solubility. A concentration of one half (1/2) of the solubility of the contaminant was chosen based on work done by the Massachusetts Department of Environmental Protection in development of their clean-up standards for hazardous waste site assessment and remediation (MDEP 1994) to decrease the presence of undissolved contaminant (free product). Undissolved contaminant poses the problem of continued degradation of the groundwater.

Quantitation Limits

For the purposes of this document, a quantitation limit (QL) is the lowest concentration at which measurements can be "trusted". Specifically, the quantitation limit is the lowest concentration of a given material (soil or water) at which measurements can be reliably achieved within specified limits of precision and accuracy by a given analytical method during routine laboratory analysis. To obtain a quantitation limit, the analyst would determine the method detection limit (MDL) per 40 CFR 136 Appendix B or the SW-846 methodology. The method detection limit takes into account the reagents, sample matrix and preparation steps applied to a sample in a specific analytical method.

The method detection limit and a multiplier is then used to determine the quantitaton limit. See EPA RAGS (EPA 1989) document for a fuller explanation of the validity of using the QL Documentation must be provided for the method detection limit and the quantitation limit.

Quantitation limits limits may be used in all Methods to determine target concentrations. The risk-based concentration determined for each contaminant is compared to the QL to insure that the target concentration can be measured with reliability. If the risk-based concentration is less than the QL, then the QL may be used as the target concentration unless the naturally occurring background concentration is higher. Where the naturally occurring background concentration is higher than the QL and target concentration, then the background concentration is used to determine the need for clean-up or other actions.

Background Concentrations

When available, the naturally occurring background concentration in groundwater and soil can be used in Methods II and III to determine target concentrations for all groundwater and soil categories. The target concentration may be set at a level equal to the established background concentration. No clean-up may be necessary at sites where a contaminant is at or below the naturally occurring background concentration.

Upon approval by the Department, anthropogenic (human-made) background concentrations may be considered for determination of target concentrations on a site-specific basis.

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APPENDIX 3. TOXICITY AND RISK ASSESSMENT REFERENCES

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APPENDIX 4. METHOD I G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	EXISTING OR INTERIM GROUNDWATER STD. 15A NCAC 2L. 0200 (mg/L)	Basis	METHOD 1 G-1 TARGET CONCENTRATIONS (mg/L)	Basis
ACENAPHTHENE	83329	0.08	ODOR	0.08	GW Standard
ACENAPHTHYLENE	208968	0.21	NONCANCER RISK	0.21	GW Standard
ACETONE	67641	0.7	NONCANCER RISK	0.7	GW Standard
ACRYLAMIDE (PROPENAMIDE)	79061	0.00001	CANCER RISK	0.00001	GW Standard
ANTHROCENE	120127	2.1	NONCANCER RISK	2.1	GW Standard
ARSENIC	7440382	0.05	MCL	0.05	GW Standard
ATRAZINE	1912249	0.003	MCL	0.003	GW Standard
BARIUM	7440393	2	MCL	2	GW Standard
BENZENE	71432	0.001	CANCER RISK	0.001	GW Standard
BENZO (a) ANTHROCENE	56553	0.0000479	CANCER RISK	0.0000479	GW Standard
BENZO (g,h,i) PERYLENE	191242	0.21	NONCANCER RISK	0.21	GW Standard
BORON	7440428	0.32	NONCANCER RISK	0.32	GW Standard
BROMODICHLOROMETHANE	75274	0.00056	CANCER RISK	0.00056	GW Standard
BROMOFORM (TRIBROMOMETHANE)	75252	0.00019	CANCER RISK	0.00019	GW Standard
BUTYLBENZYL PHTHALATE	85687	0.1	MCL	0.1	GW Standard
CADMIUM	7440439	0.005	MCL	0.005	GW Standard
CAPROLACTAM	105602	3.5	NONCANCER RISK	3.5	GW Standard
CARBOFURAN	1563662	0.036	NONCANCER RISK	0.036	GW Standard
CARBON DISULFIDE	75150	0.7	NONCANCER RISK	0.7	GW Standard
CARBON TETRACHLORIDE	56235	0.0003	CANCER RISK	0.0003	GW Standard
CHLORDANE	57749	2.70E-05	CANCER RISK	0.000027	GW Standard
CHLORIDE		250	SMCL	250	GW Standard
CHLOROBENZENE	108907	0.05	ODOR	0.05	GW Standard

APPENDIX 4. METHOD I G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	EXISTING OR INTERIM GROUNDWATER STD. 15A NCAC 2L. 0200 (mg/L)	Basis	METHOD 1 G-1 TARGET CONCENTRATIONS (mg/L)	Basis
CHLOROETHANE	75003	2.8	NONCANCER RISK	2.8	GW Standard
CHLOROFORM (TRICHLOROMETHANE)	67663	0.00019	CANCER RISK	0.00019	GW Standard
2-CHLOROPHENOL	95578	0.0001	NONCANCER RISK	0.0001	GW Standard
CHRYSENE	218019	0.00479	CANCER RISK	0.00479	GW Standard
CHROMIUM		0.05	NONCANCER RISK	0.05	GW Standard
CIS-1,2-DICHLOROETHENE	156592	0.07	NONCANCER RISK	0.07	GW Standard
COPPER	7440508	1	SMCL	1	GW Standard
CYANIDE	57125	0.154	NONCANCER RISK	0.154	GW Standard
1,2-DICHLOROBENZENE (o-DCB)	95501	0.62	NONCANCER RISK	0.62	GW Standard
1,3-DICHLOROBENZENE (m-DCB)	541731	0.62	NONCANCER RISK	0.62	GW Standard
1,4-DICHLOROBENZENE (p-DCB)	106467	0.075	MCL	0.075	GW Standard
2,4-D (2,4-DICHLOROPHENOXY ACETIC ACID)	94757	0.07	NONCANCER RISK	0.07	GW Standard
1,2-DIBROMO-3-CHLOROPROPANE	96128	2.50E-05	CANCER RISK	0.000025	GW Standard
DICHLORODIFLUOROMETHANE (FREON-12; HALON)	75718	1.4	NONCANCER RISK	1.4	GW Standard
1,1 DICHLOROETHANE	75343	0.7	NONCANCER RISK	0.7	GW Standard
1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	107062	0.00038	CANCER RISK	0.00038	GW Standard
1,1-DICHLOROETHYLENE (VINYLIDENE CHLORIDE)	75354	0.007	NONCANCER RISK	0.007	GW Standard
1,2-DICHLOROPROPANE	78875	0.00056	CANCER RISK	0.00056	GW Standard
1,3-DICHLOROPROPENE (cis AND trans ISOMERS)	542756	0.00019	CANCER RISK	0.00019	GW Standard
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742	0.7	NONCANCER RISK	0.7	GW Standard
DIETHYLPHTHALATE (DEP)	84662	5	MCL	5	GW Standard
DI (OR BIS) (2-ETHYLHEXYL) PHTHALATE (DEHP)	117817	0.003	CANCER RISK	0.003	GW Standard
DI-N-OCTYL PHTHALATE	117840	0.14	NONCANCER RISK	0.14	GW Standard

APPENDIX 4. METHOD I G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	EXISTING OR INTERIM GROUNDWATER STD. 15A NCAC 2L. 0200		METHOD 1 G-1 TARGET CONCENTRATIONS	
		(mg/L)	Basis	(mg/L)	Basis
P-DIOXANE (1,4-DIETHYLENE DIOXIDE)	123911	0.007	CANCER RISK	0.007	GW Standard
DIOXIN	1746016	2.20E-10	CANCER RISK	2.2E-10	GW Standard
DIPHENYL (BIPHENYL)	92524	0.35	NONCANCER RISK	0.35	GW Standard
DISSOLVED SOLIDS (TOTAL)		500	SMCL	500	GW Standard
DIUNDECYL PHTHALATE (SANTICIZER 711)	3648202	0.14	NONCANCER RISK	0.14	GW Standard
ENDRIN	72208	0.002	MCL	0.002	GW Standard
EPICHLOROHYDRIN (1-CHLORO-2,3-EPOXYPROPANE)	106898	0.00354	CANCER RISK	0.00354	GW Standard
ETHYLBENZENE	100414	0.029	ODOR	0.029	GW Standard
ETHYLENE DIBROMIDE (EDB; 1,2-DIBROMOETHANE)	106934	4.00E-07	CANCER RISK	0.0000004	GW Standard
ETHYLENE GLYCOL	107211	7	NONCANCER RISK	7	GW Standard
FLUORANTHENE	206440	0.28	NONCANCER RISK	0.28	GW Standard
FLUORENE	86737	0.28	NONCANCER RISK	0.28	GW Standard
FLUORIDE	7782414	2	SMCL	2	GW Standard
GROSS ALPHA (ADJUSTED) PARTICLE ACTIVITY (EXCLUDING RADIUM-226 AND URANIUM)	15 pCi/l		CANCER RISK	15 pCi/l	GW Standard
HEPTACHLOR	76448	8.00E-06	CANCER RISK	0.000008	GW Standard
HEPTACHLOR EPOXIDE	1024573	4.00E-06	CANCER RISK	0.000004	GW Standard
HEPTANE	142825	2.1	NONCANCER RISK	2.1	GW Standard
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741	0.00002	CANCER RISK	0.00002	GW Standard
N-HEXANE	110543	0.42	NONCANCER RISK	0.42	GW Standard
IRON	7439896	0.3	SMCL	0.3	GW Standard
ISOPROPYL ETHER (DIISOPROPYL ETHER)	108203	0.07	NONCANCER RISK	0.07	GW Standard
LEAD	7439921	0.015	NONCANCER RISK	0.015	GW Standard
LINDANE	58899	2.00E-04	MCL	0.0002	GW Standard

APPENDIX 4. METHOD I G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	EXISTING OR INTERIM GROUNDWATER STD. 15A NCAC 2L. 0200 (mg/L)	Basis	METHOD 1 G-1 TARGET CONCENTRATIONS (mg/L)	Basis
MANGANESE	7439965	0.05	SMCL	0.05	GW Standard
MERCURY	7439976	0.0011	NONCANCER RISK	0.0011	GW Standard
METHANOL	67561	3.5	NONCANCER RISK	3.5	GW Standard
METHOXYCHLOR	72435	0.035	NONCANCER RISK	0.035	GW Standard
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092	0.005	MCL	0.005	GW Standard
METHYL ETHYL KETONE (MEK; 2-BUTANONE)	78933	0.17	NONCANCER RISK	0.17	GW Standard
METHYL TERT-BUTYL ETHER (MTBE)	1634044	0.2	NONCANCER RISK	0.2	GW Standard
NAPHTHALENE	91203	0.021	ODOR	0.021	GW Standard
NICKEL	7440020	0.1	MCL	0.1	GW Standard
NITRATE (AS N)	14797558	10	MCL	10	GW Standard
NITRITE (AS N)	14797650	1	MCL	1	GW Standard
OXAMYL	23135220	0.175	NONCANCER RISK	0.175	GW Standard
PENTACHLOROPHENOL	87865	0.0003	CANCER RISK	0.0003	GW Standard
PHENANTHRENE	85018	0.21	NONCANCER RISK	0.21	GW Standard
PHENOL	108952	0.3	TASTE	0.3	GW Standard
PYRENE	129000	0.21	NONCANCER RISK	0.21	GW Standard
RADIUM-226 AND RADIUM-228 (COMBINED)		5 pCi/l	CANCER RISK	5 pCi/l	GW Standard
SELENIUM	7782492	0.05	MCL	0.05	GW Standard
SILVER	7440224	0.018	NONCANCER RISK	0.018	GW Standard
SIMAZINE	122349	0.0035	NONCANCER RISK	0.0035	GW Standard
STYRENE (ETHENYLBENZENE)	100425	0.1	MCL	0.1	GW Standard
SULFATE		250	SMCL	250	GW Standard
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184	0.0007	CANCER RISK	0.0007	GW Standard

APPENDIX 4. METHOD I G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	EXISTING OR INTERIM GROUNDWATER STD. 15A NCAC 2L. 0200		METHOD 1 G-1 TARGET CONCENTRATIONS	
		(mg/L)	Basis	(mg/L)	Basis
TOLUENE (METHYLBENZENE)	108883	1	MCL	1	GW Standard
TOXAPHENE	8001352	3.10E-05	CANCER RISK	0.000031	GW Standard
2, 4, 5,-TP (SILVEX)	93721	0.05	MCL	0.05	GW Standard
TRANS-1,2-DICHLOROETHENE	156605	0.07	NONCANCER RISK	0.07	GW Standard
1,1,1-TRICHLOROETHANE (METHYL CHLOROFORM)	71556	0.2	MCL	0.2	GW Standard
TRICHLOROETHYLENE (TCE)	79016	0.0028	CANCER RISK	0.0028	GW Standard
TRICHLOROFLUOROMETHANE	75694	2.1	NONCANCER RISK	2.1	GW Standard
VINYL CHLORIDE (CHLOROETHYLENE)	75014	1.50E-05	CANCER RISK	0.000015	GW Standard
XYLENES (O-, M-, AND P-)	1330207	0.53	ODOR	0.53	GW Standard
ZINC	7440666	2.1	NONCANCER RISK	2.1	GW Standard

APPENDIX 5. METHOD I G-2 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	HENRY'S LAW CONSTANT (*) (atm.-m³/mol.)	MOLECULAR WEIGHT (*) (g/mole)	Rfdi (**) (mg/kg/day)	20% RfC (mg/m³)	CPSi (**) (kg-d/mg)	IUR (mg/m³)⁻¹	CANCER RISK-BASED CONC. (mg/m³)	ODOR THRESHOLD (*) (mg/m³)	TARGET INDOOR AIR CONC. (mg/m³)	SOURCE CONC. IN GRDWTR (***) (mg/L)	GROUND-WATER STANDARD (mg/L)	1000 X GROUND-WATER STANDARD (mg/L)	50% SOLUBI-LITY (*) (mg/L)	METHOD I G-2 TARGET CONCENTRA-TIONS	
															(mg/L)	Basis
BENZENE	71432	5.50E-03	78	1.71E-03	1.20E-03	2.90E-02	8.29E-03	1.21E-04	4.89E+00	1.21E-04	1.03E-02	1.00E-03	1	890	0.0103	Source
BIS (2-CHLOROETHYL) ETHER	111444	1.30E-05	143			1.16E+00	3.31E-01	3.02E-06	2.87E-01	3.02E-06	1.09E-01			5100	0.1086	Source
BIS (2-CHLOROISOPROPYL) ETHER	39638329	1.13E-04	171			3.50E-02	1.00E-02	1.00E-04	2.24E+00	1.00E-04	4.14E-01			850	0.4142	Source
BROMOMETHANE	74839	1.97E-01	95	1.43E-03	1.00E-03				8.00E+01	1.00E-03	2.38E-03			8750	0.0024	Source
CARBON TETRACHLORIDE	56235	2.93E-02	154	5.71E-04	4.00E-04	5.25E-02	1.50E-02	6.67E-05	6.30E+01	6.67E-05	1.06E-03	3.00E-04	0.3	400	0.0011	Source
CHLOROBENZENE	108907	3.93E-03	113	5.71E-03	4.00E-03				1.00E+00	4.00E-03	4.76E-01	5.00E-02	50	244	0.4760	Source
CHLOROFORM (TRICHLOROMETHANE)	67663	3.39E-03	119			8.05E-02	2.30E-02	4.35E-05	4.22E+02	4.35E-05	6.00E-03	1.90E-04	0.19	4650	0.0060	Source
1,2-DICHLOROBENZENE (o-DCB)	95501	1.94E-03	147	4.00E-02	2.80E-02				3.05E+02	2.80E-02	6.75E+00	6.20E-01	620	72.5	6.7546	Source
1,4-DICHLOROBENZENE (p-DCB)	106467	2.72E-03	147	2.29E-01	1.60E-01				1.10E+00	1.60E-01	2.76E+01	7.50E-02	75	39.5	27.5810	Source
1,1-DICHLOROETHANE	75343	5.45E-03	99	1.43E-01	1.00E-01				1.25E+02	1.00E-01	8.60E+00	0.7	700	2750	8.5957	Source
1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	107062	1.10E-03	99	2.86E-03	2.00E-03	9.10E-02	2.60E-02	3.85E-05	2.42E+00	3.85E-05	1.64E-02	0.00038	0.38	4345	0.0164	Source
1,1-DICHLOROETHYLENE (VINYLIDENE CHLORIDE)	75354	1.49E-02	97			1.75E-01	5.00E-02	2.00E-05	1.25E+02	2.00E-05	6.28E-04	0.007	7	105	0.0006	Source
1,2-DICHLOROPROPANE	78875	2.82E-03	113	1.14E-03	7.98E-04				1.19E+00	7.98E-04	1.32E-01	0.00056	0.56	1350	0.1324	Source
1,3-DICHLOROPROPENE	542756	3.50E-03	111	5.71E-03	4.00E-03	1.30E-01	3.71E-02	2.69E-05	4.61E+00	2.69E-05	3.60E-03	0.00019	0.19	1350	0.0036	Source
ETHYLBENZENE	100414	3.43E-03	106	2.86E-01	2.00E-01				2.00E+00	2.00E-01	2.73E+01	0.029	29	80.5	27.3159	Source
ETHYLENE DIBROMIDE (EDB, 1,2-DIBROMOETHANE)	106934	6.73E-04	188	5.71E-05	4.00E-05	7.70E-01	2.20E-01	4.55E-06	2.00E+02	4.55E-06	3.16E-03	4E-07	0.0004	2150	0.0004	GWSTD
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	78933	2.74E-05	72	2.86E-01	2.00E-01				3.20E+01	2.00E-01	3.42E+03	0.17	170	137500	170.0000	GWSTD
METHYL ISOBUTYL KETONE (MIBK)	108101	1.38E-04	100	2.29E-02	1.60E-02				9.70E+00	1.60E-02	5.44E+01			9550	54.3626	Source
METHYL TERT-BUTYL ETHER (MTBE)	1634044	5.91E-04	88	8.57E-01	6.00E-01					6.00E-01	4.75E+02	0.2	200	24000	200.0000	GWSTD

APPENDIX 5. METHOD I G-2 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	HENRY'S LAW CONSTANT (*) (atm.-m³/mol.)	MOLECULAR WEIGHT (*) (g/mole)	Rfdi (**) (mg/kg/day)	20% RfC (mg/m³)	CPSi (**) (kg-d/mg)	IUR (mg/m³)⁻¹	CANCER RISK-BASED CONC. (mg/m³)	ODOR THRESHOLD (*) (mg/m³)	TARGET INDOOR AIR CONC. (mg/m³)	SOURCE CONC. IN GRDWTR (***) (mg/L)	GROUND-WATER STANDARD (mg/L)	1000 X GROUND-WATER STANDARD (mg/L)	50% SOLUBI-LITY (*) (mg/L)	METHOD I G-2 TARGET CONCENTRA-TIONS (mg/L)	Basis
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092	3.19E-03	85	8.57E-01	6.00E-01	1.64E-03	4.69E-04	2.13E-03	5.40E+02	2.13E-03	3.13E-01		5	8350	0.3131	Source
STYRENE (ETHENYLBENZENE)	100425	2.61E-03	104	2.86E-01	2.00E-01				1.36E+00	2.00E-01	3.59E+01	0.1	100	150	35.8979	Source
1,1,1,2-TETRACHLOROETHANE	630206	1.10E-02	168			2.59E-02	7.40E-03	1.35E-04		1.35E-04	5.75E-03			100	0.0057	Source
1,1,2,2-TETRACHLOROETHANE	79345	3.80E-04	168			2.03E-01	5.80E-02	1.72E-05	1.05E+01	1.72E-05	2.12E-02			1450	0.0212	Source
TETRACHLOROETHYLENE (PERCHLOROETHYLENE)	127184	2.04E-03	166			2.03E-03	5.80E-04	1.72E-03	3.17E+01	1.72E-03	3.96E-01	0.0007	0.7	100	0.3955	Source
TOLUENE (METHYLBENZENE)	108883	6.68E-03	92	1.14E-01	7.98E-02				3.00E+01	7.98E-02	5.59E+00	1	1000	267.5	5.5908	Source
1,2,4-TRICHLOROBENZENE	120821	1.42E-03	181	5.71E-02	4.00E-02				2.20E+01	4.00E-02	1.32E+01			9.5	9.5000	Solubility
1,1,1-TRICHLOROETHANE (METHYL CHLOROFORM)	71556	2.31E-02	133	2.86E-01	2.00E-01				6.51E+01	2.00E-01	4.06E+00	0.2	200	365	4.0560	Source
1,1,2-TRICHLOROETHANE	79005	9.10E-04	133			5.60E-02	1.60E-02	6.25E-05		6.25E-05	3.21E-02			2250	0.0321	Source
TRICHLOROETHYLENE (TCE)	79016	9.12E-03	131			6.00E-03	1.71E-03	5.83E-04	1.00E+03	5.83E-04	2.99E-02	0.0028	2.8	550	0.0299	Source
VINYL CHLORIDE	75014	2.78E-02	63			3.00E-01	8.57E-02	1.17E-05	7.71E+02	1.17E-05	1.96E-04	0.000015	0.015	0.55	0.0002	Source
XYLENES (o, m, AND p)	1330207	5.27E-03	106	8.57E-02	6.00E-02				4.41E-01	6.00E-02	5.33E+00	0.53	530	85.5	5.3274	Source

(*) - Source: "Background Documentation for the Development of the MCP Numerical Standards. Massachusetts Department of Environmental Protection - Bureau of Waste Site Cleanup and Office of Research and Standards (April 1994)

(**) - Source: U.S. Environmental Protection Agency, Region III - Risk-Based Concentration Table (April 18, 1996)

(***) - Groundwater concentration corresponding to target indoor air concentration

EQUATIONS

20% RfC = (Rfdi * 0.2 * 70)/20 IUR = INHALATION UNIT RISK = (CPSi * 20)/70 CANCER RISK-BASED = 1x10^{-6}/INHALAT ION UNIT RISK

TARGET INDOOR AIR CONCENTRATION = LOWEST OF 20% RfC, CANCER RISK-BASED & ODOR THRESHOLD

SOURCE CONCENTRATION IN GROUNDWATER = 0.468 * (TARGET INDOOR AIR CONCENTRATION/HENRY'S LAW CONSTANT)

G-2 METHOD I TARGET CONCENTRATION = LOWEST OF (1000 X GROUNDWATER STANDARD), (50% SOLUBILITY) & (SOURCE CONCENTRATION IN GROUNDWATER)

APPENDIX 6.
Methods I and II G-3 Calculated Source Concentrations: Methodology and Procedures

INTRODUCTION

The Methods I and II G-3 methodology starts with the surface water quality standard for a particular chemical, then works backwards through the various mixing and transport processes to arrive at a groundwater Calculated Source Concentration. This groundwater Calculated Source Concentration is the maximum contaminant concentration that may exist in groundwater without exceeding surface water quality standards and is used in determining the Target Concentration. The contaminant groundwater plume may be directly beneath the contaminant spill site or may be some distance down-gradient of the actual spill site at a particular time of assessment.

The methodology is based upon the fact that, given certain limitations, the partial differential equation that describes contaminant transport in porous media is linear with respect to chemical concentration; that is, the transport equation can be considered a linear system, and responds accordingly. This fact allows the application of the superposition principle (Reilly et. al. 1987) and relative attenuation factors. As a result, an overall transport/mixing attenuation factor may be calculated for a particular contaminant and a given hydrogeologic setting which defines the ratio of the groundwater Calculated Source Concentration to the final surface water standard concentration.

The attenuation factor is applicable to any source concentration, as long as the chemical remains soluble. The superposition principle may be used unless conditions exist which result in non-linear effects:

- non-linear chemical sorption isotherms,
- non-linear biodegradation caused by complicating kinetics, and
- non-linear complex boundary conditions.

In general, even if there are mild non-linear effects, superposition and overall attenuation factors may still be used satisfactorily if the errors are small.

For Methods I and II, certain simplifying and conservative assumptions for the hydrogeologic setting are made. These assumptions are presented following steps 1 and 2 of the G-3 Groundwater Contaminant Transport Model (G3CTM). This model was used in calculating the groundwater Calculated Source Concentrations.

The G-3 Groundwater Contaminant Transport Model (G3CTM) is based on software found in Groundwater Transport: Handbook of Mathematical Models (Javandel et al. 1984). The following parameters are considered in arriving at the Calculated Source Concentration for each contaminant:

- Surface water quality standards;
- Low-flow characteristics of potentially impacted surface water bodies (only Method II);
- Hydrogeological characteristics of the affected aquifer;
- Distance of contaminant source to the surface water body; and
- Dimensions of the groundwater plume.

The G3CTM model is made up of two parts. Step 1 calculates the transport of the groundwater contaminant plume from some defined position and time (defined as time=0) to some future point in time (time = xx years), in order to predict the maximum contaminant concentrations in the groundwater at the surface water boundary. This future point in time is chosen to be that point in time at which the maximum plume concentration is discharging to the surface water body.

G3CTM performs a one-dimensional analysis, in the direction of groundwater flow, considering:

- advection;
- longitudinal dispersion;
- chemical retardation; and
- in-situ chemical biodegradation via first-order decay process.

Step 1 assumes no lateral dispersion, that the contaminant plume is uniformly spread throughout the depth of the surficial aquifer, and that at time = 0 the contaminant plume is initially uniformly spread throughout the areal extent of the plume size at the Calculated Source Concentration (to be determined).

Step 2 of the G3CTM considers the mixing effect of groundwater and surface water. G3CTM uses a mixing formula to calculate the mixing of a groundwater contaminant with surface water to produce a surface water contaminant concentration. As part of the calculation, the low-flow characteristic of the surface water body (7Q10) is used. The mixing formula assumes that the entire surficial groundwater aquifer discharges into the surface water body, and that the groundwater discharging into the surface water body completely mixes with the 7Q10 flow at the point of contact.

The G3CTM was used in generating the Method I G-3 target concentrations found in Table 3.2 and the table located at the end of this appendix. To determine the Method II G-3 target concentrations, the responsible party uses the G3CTM and site-specific data to calculate groundwater Calculated Source Concentrations. See Chapter 3 for complete details. A copy of the G3CTM is included with each copy of this document.

DESCRIPTION OF G3CTM

The following description will guide the responsible party through the process of running the G3CTM model to arrive at a groundwater Calculated Source Concentration for use in calculating Method II G-3 Target Concentrations. The assumptions used in the development of the G3CTM model, its limitations and a description of Method I G-3 Target Concentrations assumptions are listed at the end of this appendix.

Method II Step 1

In order to run G3CTM, type G3CTM within the subdirectory in which the program is located. The first screen will give basic information about the program. The next screen asks for the chemical contaminant name and its associated surface water quality standard (15A NCAC 2B.0200). Once this data is entered, the program will display the Step 1 Groundwater Transport data entry screen as shown in Figure A6.1.

When first run, the Method II Step 1 Groundwater Transport data entry screen will display some initial values as examples. Replace these values with data that are specific to the site being evaluated. As the program progresses, it will save the newest data; overwriting the initial data set. When the program is next run, the data last entered will be displayed. This data will also be overwritten when a new data set is entered.

The responsible party does not enter values for Calculated Average Groundwater Velocity. This parameter is calculated by the following formula: $v = Ki/n_e$ using values input for parameters 2 through 4 in Figure A6.1.

Figure A6.1. Method II Step 1 Groundwater Transport [data entry screen]

PARAMETER MENU**	UNITS	INITIAL VALUE*
(1) DISTANCE FROM PLE TO SURFACE WATER BODY	(feet)	200
PLE = PLUME LEADING EDGE		
(2) AQUIFER HYDRAULIC CONDUCTIVITY (K)	(feet/day)	10
(3) AQUIFER GROUNDWATER GRADIENT (i)	(feet/feet)	0.01
(4) AQUIFER EFFECTIVE POROSITY (n_e)	(unitless)	0.3
(5) AQUIFER DISPERSION COEFFICIENT	(feet^2/day)	30
(6) CHEMICAL RETARDATION FACTOR	(unitless)	1.0
(7) CHEMICAL BIODEGRADATION DECAY RATE	(1/day)	0.0
(8) LENGTH OF CONTAMINANT PLUME	(feet)	100
Calculated Average Groundwater Velocity	(feet/day)	0.33333
	(feet/year)	121.750

*These values are used as examples only. They are not default values and must be changed to those that are representative of actual site conditions.

** Parameter definitions are provided on page A6.5

Once the values for parameters 1 through 8 are entered into the data entry screen, press the "F3" key. The software will perform the appropriate calculations and yield the following information:

Maximum Groundwater Contaminant Concentration at
Surface Water Boundary Occurs at Time = ______ years
with Groundwater Concentration C/C_{source} = ________
where C_{source} = Maximum Source Concentration

Once this information is displayed, the software will generate a plot showing the contaminant concentration in groundwater versus time. This concludes Step 1 in the process to calculate the Calculated Source Concentration. The final outcome of Step 1 is the Groundwater Concentration C/C_{source}.

Step 2

Pressing any key and exiting the plot initializes Step 2 of the modeling software. Step 2 uses a mixing formula to calculate the mixing of a groundwater contaminant with surface water to produce a surface water contaminant concentration and ultimately the Calculated Source Concentration. The Method II Step 2 Groundwater/Surface water data entry screen is depicted in Figure A6.2

Figure A6.2. Method II Step 2 Groundwater/Surface Water Mixing [data entry screen]

PARAMETER MENU**	UNITS	INITIAL VALUE*
(1) THICKNESS OF SURFICIAL AQUIFER	(feet)	30
(2) WIDTH OF CONTAMINANT PLUME	(feet)	50
(3) 7Q10 OF RIVER OR STREAM	($feet^3/sec$)	2.0
(4) UPSTREAM CHEMICAL CONCENTRATION	(mg/L)	0.0
GROUNDWATER FLUX TO STREAM (Q_{gw})	($feet^3/day$)	0.1500E+03
STREAM 7Q10 (Q_{sw})	($feet^3/day$)	0.1728E+03
RATIO OF Qsw/Q_{gw}		0.1152E+04

*These values are used as examples only. They are not default values and must be changed to those that are representative of actual site conditions.

** Parameter definitions are provided on page A6.8

When first run, the Method II Step 2 Groundwater Transport Data Entry Screen will display some initial values as examples. Replace those values with data that is specific to the site being analyzed. As the program progresses, it will save the newest data; overwriting the initial data set. When the program is next run, the data last entered will be displayed. This data will also be overwritten as new data is entered.

After entering the data requested by the Method II Step 2 Groundwater/Surface Water Mixing Data Entry Screen, the Calculated Source Concentration is derived. This value is used in the determination of the G-3 Target Concentrations. For more information on the calculation of the G-3 Target Concentration, please see Chapter 3.

G3CTM PARAMETER DEFINITIONS

G3CTM Method II Step 1 Definitions

Hydraulic Conductivity (K):

Hydraulic conductivity (also called the coefficient of permeability, in units of feet/day) measures the permeability of an aquifer to fluid flow. Hydraulic conductivity (K) parameter values should be based on field data, i.e., single or multi-well aquifer pump tests, or slug tests. Table A6.1 should be used if no other field estimates are available.

Table A6.1. Aquifer Parameters for Hydrogeologic Settings in North Carolina

Geologic Material	Effective Porosity n_e	Hydraulic Conductivity K (cm/sec)	Groundwater Gradient i (ft/ft)
clayey Coastal Plain soil	0.25	10^{-2}	0.005
sandy Coastal Plain soil	0.2	10^{-1}	0.005
clayey saprolite (Piedmont)	0.2	10^{-4}	0.05
sandy saprolite (Piedmont)	0.15	10^{-2}	0.05
alluvium (Piedmont)	0.25	10^{-2}	0.05

NOTE: 1 cm/sec = 2835 feet/day

Aquifer Groundwater Gradient (i):

The aquifer groundwater gradient (feet/feet) is the average slope of the surficial groundwater table (assumed to be constant) in the direction of groundwater flow between the plume and the surface water body. Measured as change in groundwater elevation (feet) per foot of linear distance.

Effective Porosity (n_e):

Effective porosity (n_e -dimensionless units) is the ratio of interconnected void volume to the total aquifer volume. Effective porosity parameter values should be based on geologic material, using Table A6.1 in this appendix.

Longitudinal Dispersion Coefficient (D_L):

Longitudinal Dispersion (feet^2/day) measures the natural spreading of a contaminant plume during migration. Longitudinal Dispersion Coefficient (D_L) parameter values are difficult to obtain without extensive field investigations. The dispersion coefficient depends not only on the variability of the local hydraulic conductivity at the site, but also on the scale of the problem (i.e., the distance from the source to the surface water receptor). See Fetter (1993) or Gelher et. al. (1985) for more discussions regarding these issues. The longitudinal dispersion coefficient can be estimated as follows:

$$D_L = 0.1 L_{sw} v$$

where: 0.1 = a constant,
L_{SW} = the distance from the PLE to the surface water body in feet, and
v = the average groundwater velocity in feet/day.

Distance from the Plume's Leading Edge to Surface Water Body (Lsw):

This parameter is the measured distance (feet) from the Plume Leading Edge (PLE) of the contaminant plume along the direction of groundwater flow to the nearest contact with the surface water body. The contaminant PLE is the location, based on analytical data from field investigations, of the first measurable contaminant concentration that is less than surface water quality standards down-gradient of the point of maximum contaminant concentration. Sufficient groundwater sampling data must be collected to verify the PLE chosen.

Retardation Factor (R):

Retardation Factor (dimensionless units) is the relative migration velocity of the solute chemical compared to water. The Retardation Factor (R) parameter values should be based on the formula below:

$$\mathbf{R = 1 + \frac{\rho_b K_{oc} f_{oc}}{n_e}}$$

where: ρ_b = bulk aquifer density (g/cm^3) default = 1.5 g/cm^3

K_{OC} = organic carbon-water partition coefficient (L/kg)

f_{OC} = aquifer organic fraction (unitless) default = 0.001

n_e = effective porosity (unitless)

Use the values in Tables 1 and 2 of Appendix 9 for the organic carbon-water partition coefficient (K_{OC}). The effective porosity (n_e) should be taken from Table A6.1 of this appendix. Default values are listed above for the bulk aquifer density and aquifer organic fraction.

Biodegradation Decay Rate (k):

The Biodegradation Decay Rate (1/day) measures the rate at which a contaminant is attenuated due to biological activity in the subsurface. Making use of a non-zero biodegradation decay rate (k) will only be allowed for certain chemicals. For the following chemicals, NO biodegradation decay will be allowed (k=0), unless evidence is presented otherwise for the particular site:

- Methyl tert-butyl ether (MTBE);
- Halogenated organic compounds (e.g., organochlorine pesticides, some PAHs, PCBs, and some brominated and chlorinated solvents), and
- Metals.

Non-zero biodegradation ($k > 0$) will be allowed for certain volatile organic chemicals. The decay rate (k) will be established at a pre-set number for each chemical. Higher decay rates may be used if site-specific evidence justifying the increase is presented.

Length of Contaminant Plume:

The length of the plume (feet) is the distance from the plume leading edge to the plume trailing edge parallel to the direction of groundwater flow. The plume trailing edge is the location, based on analytical data from field investigations, of the first-measurable contaminant concentration that is less than surface water quality standards up-gradient of the point of maximum contaminant concentration.

G3CTM Method II Step 2 Parameter Definitions

Thickness of the Surficial Aquifer:

This is a measure of the average thickness (feet) of the saturated zone of the surficial aquifer. The contaminant plume is assumed to exist uniformly throughout the entire depth of the surficial aquifer.

Width of the Contaminant Plume:

The width of the contaminant plume (feet) is defined as the maximum lateral distance across the plume (perpendicular to the direction of groundwater flow). This lateral distance is measured between the two cross-gradient locations.

7Q10 of River or Stream

The 7Q10 flow (cubic feet per second) is defined as the minimum average flow of a river or stream for a period of seven consecutive days that has an average recurrence of once in ten years [15A NCAC 2B.0206(a)(1)]. If the surface water body is a lake, pond, or reservoir, the 7Q10 flow for the stream feeding into the main body or arm of the lake, pond, or reservoir is used as appropriate. In those cases where the 7Q10 is not known, the responsible party or their representative should consult with the U.S. Geological Survey to determine an appropriate estimate of 7Q10 for the surface water body.

Upstream Chemical Concentration

The chemical concentration (mg/l) of the stream or river above (up-stream) of the predicted groundwater/surface water impact area. The up-stream chemical concentration is thus the stream background concentration.

Groundwater Flux to Stream (Q_{gw})

The groundwater flux (feet^3/day) is defined to be that portion of the surficial aquifer described by the idealized plume geometry. The groundwater flux is calculated using the formula:

$$\mathbf{Q_{gw} = v W_{plume} D_{aquifer}}$$

where: v = the average groundwater velocity,
W_{plume} = the width of the contaminant plume, and
$D_{aquifer}$ = the thickness of the surficial aquifer.

This value is calculated by the program and displayed on the screen.

Surface Water Flux (Q_{sw})

The surface water flux is the 7Q10 flow expressed in units of feet^3/day.

Ratio of Q_{sw}/Q_{gw}

The ratio of Q_{sw}/Q_{gw} is used in the calculation of the groundwater/surface water mixing concentration formula. A high ratio value (typically greater than 100) implies that the groundwater flux component is relatively small compared to the surface water flux component. This value is calculated and displayed on-screen.

ASSUMPTIONS USED IN THE DEVELOPMENT OF THE G3CTM

(1) The groundwater contaminant plume is assumed to be uniformly distributed throughout the entire saturated thickness of the surficial aquifer.

(2) The surficial aquifer is assumed to be homogeneous and isotropic. The surficial aquifer is assumed to be characterized by a single value of hydraulic conductivity, a single value of effective porosity, and by a single average groundwater gradient.

(3) The groundwater contaminant plume is assumed to be impacted by longitudinal dispersion only. Lateral (cross-gradient) dispersion is assumed to be zero.

(4) Biodegradation may not be used for certain chemicals.

(5) Chemical retardation is accounted for, but the organic fraction of the surficial aquifer is set to a conservative value, thereby forcing the chemical retardation parameters to be conservative.

(6) The entire groundwater contaminant plume is assumed to be described initially (at the time of assessment) by a single maximum concentration value.

(7) One-dimensional groundwater transport is assumed to characterize the movement of the idealized contaminant plume to the surface water body.

(8) The entire surficial aquifer is assumed to discharge to the surface water body.

(9) The groundwater flux discharged to the surface water body is completely mixed with the 7Q10 flow in the surface water body.

LIMITATIONS OF THE G3CTM

The G-3 Groundwater Contaminant Transport Model may not be used in the following hydrogeologic environments:

- Fractured Bedrock Aquifer

  The hydrogeologic characterization for fractured bedrock is generally known to have a large degree of uncertainty associated with it. Although models may exist which are designed to treat these uncertainties to some extent, G3CTM is not designed to model the complexities associated with hydrogeologic terrain of this type. Therefore, this simplistic model should not be used in fractured bedrock terrain.

- Limestone/Karst Aquifers

Like fractured bedrock aquifers, the hydrogeologic characterization of karst aquifers is generally known to have a large degree of uncertainty associated with it. Although models may exist which are designed to treat these uncertainties to some extent, G3CTM is not designed to model the complexities associated with hydrogeologic terrain of this type. Therefore, this simplistic model should not be used in karst terrain.

The G3CTM model may not be used for Method III G-3. For Method III, the responsible party chooses another groundwater flow and transport model. In general, the responsible party will choose a groundwater flow and transport model that is flexible in its ability to model different types of site geometry, boundary conditions, and spatially-varying hydrogeologic parameters, and will allow for flow and transport in either two or three dimensions. The G3CTM model is only a one dimensional model, and is not designed to be flexible in its geometry and boundary conditions.

ASSUMPTIONS FOR METHOD I G-3

In determining Method I G-3 target concentrations (Table 3.2 and Appendix 6, Table 1), surface water mixing (step 2 of G3CTM) cannot be accounted for, since no knowledge of the surface water characteristics is available. Therefore, a multiplier, as described below, was used. The contaminant groundwater transport from Step 1 of G3CTM and surface water quality standards for protection of human health (through fish consumption) and aquatic life were used to arrive at the groundwater Calculated Source Concentrations. Certain simplifying and conservative assumptions for the different hydrogeologic settings across the State of North Carolina were used, and are listed in Table A6.1. Other assumptions used in Method I G-3 are listed in Table A6.2.

Table A6.2. Parameter Assumptions Used in Development of Method I G-3 Calculated Source Concentrations.

Distance from the plume's leading edge to surface water body:	250 feet
	500 feet
	1000 feet
Chemical Retardation Factor	1.0
Chemical Biodegradation Decay Rate	0.0
Length of Contaminant Plume	100 feet
Upstream Chemical Concentration	0.0 mg/l

Each hydrogeologic setting was run through Step 1 of G3CTM at three different plume-to-surface-water-body distances (250, 500, and 1000 feet) using the values for effective porosity, hydraulic conductivity and groundwater gradient found in Table A6.1. For Method I G-3, a multiplier was calculated using the reciprocal of the Groundwater Concentration C/C_{source} generated in each run of Step 1 for the predominant geological materials found in North Carolina (Table A6.3).

The plume-to-surface-water-body distance was the only parameter found to be significant, as seen from the similar multiplier numbers in each column of Table A6.3. In other words, given the conservative assumptions listed above and disregarding the fact that the contaminant travel times for each hydrogeologic setting and distance will be different, the overall chemical attenuation is seen to be mainly dependent on distance to the surface water body.

Table A6.3. Multiplier Values by Geologic Material and Distance to Surface Water Body from the Plume Leading Edge (PLE)

	Distance to Surface Water Body from PLE		
Geologic Material	**250 feet**	**500 feet**	**1000 feet**
clayey Coastal soil	2.57	4.96	9.87
sandy Coastal soil	2.58	4.98	9.87
clayey saprolite (Piedmont)	2.6	4.96	9.88
sandy saprolite (Piedmont)	2.58	4.98	9.87
alluvium (Piedmont)	2.58	4.98	9.87
Final Multipliers for Method I* (All geologic settings)	**2.5**	**5.0**	**10.0**

* Final Multipliers were obtained by rounding the multipliers in each column to the closest half or whole number.

The final multiplier values for each PLE distance were generated by rounding the multiplier numbers to the closest half or whole number. These multipliers were then used in calculating the Method I G-3 groundwater Calculated Source Concentrations. Finally, the groundwater Calculated Source Concentrations were compared with 1000 times the groundwater quality standard or, if no groundwater standard exists, the interim standard determined per 15A NCAC 2L .0200 and 50% of chemical solubility. The lowest of these three numbers is the Method I G-3 groundwater Target Concentration listed in Table 3.2 and Table A6.4.

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Reilly, T.E., Franke, L.O. and Gordon, B. 1987. *The Principle of Superposition and Its Application in Ground-Water Hydraulics.* Techniques of Water-Resources Investigations, Book 3, Chapter B6. US Geological Survey, Denver CO.

TABLE A6.4. METHOD I G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Lowest WQS	50% Solubility	1000 times Groundwater Standard	Calculated Source Concentrations 250 Feet	Target Concentrations 250 feet**	Calculated Source Concentrations 500 Feet	Target Concentrations 500 feet**	Calculated Source Concentrations 1000 Feet	Target Concentrations 1000 ft**
2,4,5-TP (Silvex)	93721	5.90E-07	N/F	5.00E+01	1.48E-06	1.48E-06	2.95E-06	2.95E-06	5.90E-06	5.90E-06
2-Methyl-4,6-dinitrophenol	534521	7.65E-01	N/F	N/S	1.91E+00	1.91E+00	3.83E+00	3.83E+00	7.65E+00	7.65E+00
Acenaphthene	83329	2.70E+00	1.71E+00	8.00E+01	6.75E+00	1.71E+00	1.35E+01	1.71E+00	2.70E+01	1.71E+00
Acrolein	107028	7.80E-01	1.04E+05	N/S	1.95E+00	1.95E+00	3.90E+00	3.90E+00	7.80E+00	7.80E+00
Acrylonitrile	107131	6.65E-04	3.68E+04	N/S	1.66E-03	1.66E-03	3.33E-03	3.33E-03	6.65E-03	6.65E-03
Aldrin	309002	1.36E-07	8.50E-03	N/S	3.40E-07	3.40E-07	6.80E-07	6.80E-07	1.36E-06	1.36E-06
alpha-Endosulfan	959988	9.00E-06	1.60E-01	N/S	2.25E-05	2.25E-05	4.50E-05	4.50E-05	9.00E-05	9.00E-05
Anthracene	120127	1.10E+02	6.45E-01	2.10E+03	2.75E+02	6.45E-01	5.50E+02	6.45E-01	1.10E+03	6.45E-01
Antimony	7440360	4.30E+00	N/F	N/S	1.08E+01	1.08E+01	2.15E+01	2.15E+01	4.30E+01	4.30E+01
Arsenic	7440382	5.00E-02	N/F	5.00E+01	1.25E-01	1.25E-01	2.50E-01	2.50E-01	5.00E-01	5.00E-01
Benzene	71432	7.14E-02	8.90E+02	1.00E+00	1.79E-01	1.79E-01	3.57E-01	3.57E-01	7.14E-01	7.14E-01
Benzidine	92875	5.40E-07	2.00E+02	N/S	1.35E-06	1.35E-06	2.70E-06	2.70E-06	5.40E-06	5.40E-06
Benzo (b) fluoranthene	205992	4.90E-05	N/F	N/S	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Benzo(a)Anthracene	56553	4.90E-05	5.00E-03	4.79E-02	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Benzo(a)Pyrene	50328	4.90E-05	1.90E-03	N/S	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Benzo(g,h,i) perylene	191242	4.90E-05	1.30E-04	2.10E+02	1.23E-04	1.23E-04	2.45E-04	1.30E-04	4.90E-04	1.30E-04
Benzo(k)fluoranthene	207089	4.90E-05	N/F	N/S	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Beryllium	7440417	1.17E-04	N/F	N/S	2.93E-04	2.93E-04	5.85E-04	5.85E-04	1.17E-03	1.17E-03
beta-Endosulfan	33213659	9.00E-06	N/F	N/S	2.25E-05	2.25E-05	4.50E-05	4.50E-05	9.00E-05	9.00E-05
Bis(2-Ethylhexyl) phthalate	117817	5.92E-03	N/F	3.00E+00	1.48E-02	1.48E-02	2.96E-02	2.96E-02	5.92E-02	5.92E-02
Boron	7440428	7.50E-01	N/F	3.20E+02	1.88E+00	1.88E+00	3.75E+00	3.75E+00	7.50E+00	7.50E+00
Bromoform	75252	3.60E-01	1.60E+03	1.90E-01	9.00E-01	1.90E-01	1.80E+00	1.90E-01	3.60E+00	1.90E-01
Cadmium	7440439	2.00E-03	N/F	5.00E+00	5.00E-03	5.00E-03	1.00E-02	1.00E-02	2.00E-02	2.00E-02
Carbon tetrachloride	56235	4.42E-03	4.00E+02	3.00E-01	1.11E-02	1.11E-02	2.21E-02	2.21E-02	4.42E-02	4.42E-02
Chlordane	57749	5.88E-07	2.80E-02	2.70E-02	1.47E-06	1.47E-06	2.94E-06	2.94E-06	5.88E-06	5.88E-06
Chloride		2.30E-01	N/F	2.50E+05	5.75E-01	5.75E-01	1.15E+00	1.15E+00	2.30E+00	2.30E+00

TABLE A6.4. METHOD I G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Lowest WQS	50% Solubility	1000 times Groundwater Standard	Calculated Source Concentrations 250 Feet	Target Concentrations 250 feet**	Calculated Source Concentrations 500 Feet	Target Concentrations 500 feet**	Calculated Source Concentrations 1000 Feet	Target Concentrations 1000 ft**
Chlorine, total residual	7782505	1.70E-02	3.21E+03	N/S	4.25E-02	4.25E-02	8.50E-02	8.50E-02	1.70E-01	1.70E-01
Chlorobenzene	108907	2.10E+01	2.44E+02	5.00E+01	5.25E+01	5.00E+01	1.05E+02	5.00E+01	2.10E+02	5.00E+01
Chlorodibromomethane	124481	3.40E-02	N/F	N/S	8.50E-02	8.50E-02	1.70E-01	1.70E-01	3.40E-01	3.40E-01
Chloroethyl ether (bis-2)	111444	1.40E-03	5.10E-05	N/S	3.50E-03	5.10E-05	7.00E-03	5.10E-05	1.40E-02	5.10E-05
Chloroform	67663	4.70E-01	4.65E+03	1.90E-01	1.18E+00	1.90E-01	2.35E+00	1.90E-01	4.70E+00	1.90E-01
Chloroisopropyl ether (bis-2)	39638329	1.70E+02	N/F	N/S	4.25E+02	4.25E+02	8.50E+02	8.50E+02	1.70E+03	1.70E+03
Chromium, total		2.00E-02	N/F	5.00E+01	5.00E-02	5.00E-02	1.00E-01	1.00E-01	2.00E-01	2.00E-01
Chrysene	218019	4.90E-05	3.00E-03	4.79E+00	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Copper	7440508	3.00E-03	N/F	1.00E+03	7.50E-03	7.50E-03	1.50E-02	1.50E-02	3.00E-02	3.00E-02
Cyanide	57125	1.00E-03	N/F	1.54E+02	2.50E-03	2.50E-03	5.00E-03	5.00E-03	1.00E-02	1.00E-02
DDT	50293	5.91E-07	1.55E-03	N/S	1.48E-06	1.48E-06	2.96E-06	2.96E-06	5.91E-06	5.91E-06
Demeton	8065483	1.00E-04	N/F	N/S	2.50E-04	2.50E-04	5.00E-04	5.00E-04	1.00E-03	1.00E-03
Di-n-butyl phthalate	84742	1.20E+01	2.00E+02	7.00E+02	3.00E+01	3.00E+01	6.00E+01	6.00E+01	1.20E+02	1.20E+02
Dibenzo(a,h) anthracene	53703	4.90E-05	2.50E-04	N/S	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	2.50E-04
Dichlorobenzene 1,2	95501	1.70E+01	7.25E+01	6.20E+02	4.25E+01	4.25E+01	8.50E+01	7.25E+01	1.70E+02	7.25E+01
Dichlorobenzene 1,3	541731	2.60E+00	6.15E+01	6.20E+02	6.50E+00	6.50E+00	1.30E+01	1.30E+01	2.60E+01	2.60E+01
Dichlorobenzidine 3,3'	91941	7.70E-05	1.55E+00	N/S	1.93E-04	1.93E-04	3.85E-04	3.85E-04	7.70E-04	7.70E-04
Dichlorobromomethane	75274	4.60E-02	N/F	6.00E-01	1.15E-01	1.15E-01	2.30E-01	2.30E-01	4.60E-01	4.60E-01
Dichloroethane 1,2	107062	9.90E-02	4.35E+03	3.80E-01	2.48E-01	2.48E-01	4.95E-01	3.80E-01	9.90E-01	3.80E-01
Dichloroethylene 1,1	75354	3.20E-03	1.05E+02	7.00E+00	8.00E-03	8.00E-03	1.60E-02	1.60E-02	3.20E-02	3.20E-02
Dichlorophenol 2,4	120832	7.90E-01	2.25E+03	N/S	1.98E+00	1.98E+00	3.95E+00	3.95E+00	7.90E+00	7.90E+00
Dichloropropene 1,3	542756	1.70E+00	1.35E+03	1.90E-01	4.25E+00	1.90E-01	8.50E+00	1.90E-01	1.70E+01	1.90E-01
Dieldrin	60571	1.44E-07	9.30E-02	N/S	3.60E-07	3.60E-07	7.20E-07	7.20E-07	1.44E-06	1.44E-06
Diethyl phthalate	84662	1.20E+02	N/F	5.00E+03	3.00E+02	3.00E+02	6.00E+02	6.00E+02	1.20E+03	1.20E+03

TABLE A6.4. METHOD I G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Lowest WQS	50% Solubility	1000 times Groundwater Standard	Calculated Source Concentrations 250 Feet	Target Concentrations 250 feet**	Calculated Source Concentrations 500 Feet	Target Concentrations 500 feet**	Calculated Source Concentrations 1000 Feet	Target Concentrations 1000 ft**
Dimethyl phthalate	131113	2.90E+03	2.50E+03	N/S	7.25E+03	2.50E+03	1.45E+04	2.50E+03	2.90E+04	2.50E+03
Dinitrophenol 2,4	51285	1.40E+01	2.80E+03	N/S	3.50E+01	3.50E+01	7.00E+01	7.00E+01	1.40E+02	1.40E+02
Dinitrotoluene 2,4	121142	9.10E-03	1.35E+02	N/S	2.28E-02	2.28E-02	4.55E-02	4.55E-02	9.10E-02	9.10E-02
Dioxin 2,3,7,8-TCDD ONLY	1746016	1.40E-08	N/F	2.20E-07	3.50E-08	3.50E-08	7.00E-08	7.00E-08	1.40E-07	1.40E-07
Diphenylhydrazine 1,2	122667	5.40E-04	1.11E+02	N/S	1.35E-03	1.35E-03	2.70E-03	2.70E-03	5.40E-03	5.40E-03
Endosulfan sulfate	1031078	9.00E-06	1.10E-01	N/S	2.25E-05	2.25E-05	4.50E-05	4.50E-05	9.00E-05	9.00E-05
Endrin	72208	2.00E-06	1.30E-01	2.00E+00	5.00E-06	5.00E-06	1.00E-05	1.00E-05	2.00E-05	2.00E-05
Endrin aldehyde	7421934	8.10E-04	N/F	N/S	2.03E-03	2.03E-03	4.05E-03	4.05E-03	8.10E-03	8.10E-03
Ethylbenzene	100414	2.90E+01	8.05E+01	2.90E+01	7.25E+01	2.90E+01	1.45E+02	2.90E+01	2.90E+02	2.90E+01
Fluoranthene	206440	3.70E-01	1.33E-01	2.80E+02	9.25E-01	1.33E-01	1.85E+00	1.33E-01	3.70E+00	1.33E-01
Fluorene	86737	6.40E+01	9.50E-01	2.80E+02	1.60E+02	9.50E-01	3.20E+02	9.50E-01	6.40E+02	9.50E-01
Fluoride	7782414	1.80E-03	N/F	2.00E+03	4.50E-03	4.50E-03	9.00E-03	9.00E-03	1.80E-02	1.80E-02
Guthion (Azinophos methyl)	86500	1.00E-05	N/F	N/S	2.50E-05	2.50E-05	5.00E-05	5.00E-05	1.00E-04	1.00E-04
Heptachlor	76448	2.14E-07	2.80E-02	8.00E-03	5.35E-07	5.35E-07	1.07E-06	1.07E-06	2.14E-06	2.14E-06
Heptachlor epoxide	1024573	1.10E-07	1.75E-01	4.00E-03	2.75E-07	2.75E-07	5.50E-07	5.50E-07	1.10E-06	1.10E-06
Hexachlorobenzene	118741	7.70E-07	5.50E-02	2.00E-02	1.93E-06	1.93E-06	3.85E-06	3.85E-06	7.70E-06	7.70E-06
Hexachlorobutadiene	87683	4.97E-02	1.00E+00	N/S	1.24E-01	1.24E-01	2.49E-01	2.49E-01	4.97E-01	4.97E-01
Hexachlorocyclohexane-alpha	319846	1.30E-05	N/F	N/S	3.25E-05	3.25E-05	6.50E-05	6.50E-05	1.30E-04	1.30E-04
Hexachlorocyclohexane-beta	319857	4.60E-05	N/F	N/S	1.15E-04	1.15E-04	2.30E-04	2.30E-04	4.60E-04	4.60E-04
Hexachlorocyclopentadiene	77474	1.70E+01	9.00E-01	N/S	4.25E+01	9.00E-01	8.50E+01	9.00E-01	1.70E+02	9.00E-01
Hexachloroethane	67721	8.90E-03	2.50E+01	N/S	2.23E-02	2.23E-02	4.45E-02	4.45E-02	8.90E-02	8.90E-02
Indeno(1,2,3-cd) pyrene	193395	4.90E-05	N/F	N/S	1.23E-04	1.23E-04	2.45E-04	2.45E-04	4.90E-04	4.90E-04
Iron	7439896	1.00E+00	N/F	3.00E+02	2.50E+00	2.50E+00	5.00E+00	5.00E+00	1.00E+01	1.00E+01
Isophorone	78591	2.60E+00	6.00E+03	N/S	6.50E+00	6.50E+00	1.30E+01	1.30E+01	2.60E+01	2.60E+01

TABLE A6.4. METHOD I G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Lowest WQS	50% Solubility	1000 times Groundwater Standard	Calculated Source Concentrations 250 Feet	Target Concentrations 250 feet**	Calculated Source Concentrations 500 Feet	Target Concentrations 500 feet**	Calculated Source Concentrations 1000 Feet	Target Concentrations 1000 ft**
Lead	7439921	2.50E-02	N/F	1.50E+01	6.25E-02	6.25E-02	1.25E-01	1.25E-01	2.50E-01	2.50E-01
Lindane (gamma-BHC)	58899	4.00E-06	N/F	2.00E-01	1.00E-05	1.00E-05	2.00E-05	2.00E-05	4.00E-05	4.00E-05
Malathion	121755	1.00E-04	7.25E+01	N/S	2.50E-04	2.50E-04	5.00E-04	5.00E-04	1.00E-03	1.00E-03
Manganese	7439965	1.00E-01	N/F	5.00E+01	2.50E-01	2.50E-01	5.00E-01	5.00E-01	1.00E+00	1.00E+00
Mercury	7439976	1.20E-05	2.80E-02	1.10E+00	3.00E-05	3.00E-05	6.00E-05	6.00E-05	1.20E-04	1.20E-04
Methoxychlor	72435	3.00E-05	2.00E-02	3.50E+01	7.50E-05	7.50E-05	1.50E-04	1.50E-04	3.00E-04	3.00E-04
Methyl bromide	74839	4.00E+00	8.75E+03	N/S	1.00E+01	1.00E+01	2.00E+01	2.00E+01	4.00E+01	4.00E+01
Methylene chloride	75092	1.60E+00	8.35E+03	5.00E+00	4.00E+00	4.00E+00	8.00E+00	5.00E+00	1.60E+01	5.00E+00
Mirex	2385855	1.00E-06	1.00E-01	N/S	2.50E-06	2.50E-06	5.00E-06	5.00E-06	1.00E-05	1.00E-05
N-Nitrosodiphenylamine	86306	1.60E-02	1.75E+01	N/S	4.00E-02	4.00E-02	8.00E-02	8.00E-02	1.60E-01	1.60E-01
Nickel	7440020	8.30E-03	N/F	1.00E+02	2.08E-02	2.08E-02	4.15E-02	4.15E-02	8.30E-02	8.30E-02
Nitrobenzene	98953	1.90E+00	9.50E+02	N/S	4.75E+00	4.75E+00	9.50E+00	9.50E+00	1.90E+01	1.90E+01
Nitrosodimethylamine N	62759	8.10E-03	N/F	N/S	2.03E-02	2.03E-02	4.05E-02	4.05E-02	8.10E-02	8.10E-02
Parathion	56382	1.30E-05	1.20E+01	N/S	3.25E-05	3.25E-05	6.50E-05	6.50E-05	1.30E-04	1.30E-04
PCB-1016	12674112	7.90E-05	2.45E-02	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1221	11104282	7.90E-05	2.95E-01	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1232	11141165	7.90E-05	7.25E-01	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1242	53469219	7.90E-05	N/F	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1248	12672296	7.90E-05	2.70E-02	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1254	11097691	7.90E-05	2.85E-02	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
PCB-1260	11096826	7.90E-05	4.00E-02	N/S	1.98E-04	1.98E-04	3.95E-04	3.95E-04	7.90E-04	7.90E-04
Pentachlorophenol	87865	7.90E-03	7.00E+00	3.00E-01	1.98E-02	1.98E-02	3.95E-02	3.95E-02	7.90E-02	7.90E-02
Phenanthrene	85018	2.90E-02	4.08E-01	2.10E+02	7.25E-02	7.25E-02	1.45E-01	1.45E-01	2.90E-01	2.90E-01
Phenol	108952	4.60E+03	4.00E+04	3.00E+02	1.15E+04	3.00E+02	2.30E+04	3.00E+02	4.60E+04	3.00E+02

TABLE A6.4. METHOD I G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Lowest WQS	50% Solubility	1000 times Groundwater Standard	Calculated Source Concentrations 250 Feet	Target Concentrations 250 feet**	Calculated Source Concentrations 500 Feet	Target Concentrations 500 feet**	Calculated Source Concentrations 1000 Feet	Target Concentrations 1000 ft**
Pyrene	129000	1.10E+01	8.00E-02	2.10E+02	2.75E+01	8.00E-02	5.50E+01	8.00E-02	1.10E+02	8.00E-02
Selenium	7782492	5.00E-03	N/F	5.00E+01	1.25E-02	1.25E-02	2.50E-02	2.50E-02	5.00E-02	5.00E-02
Silver	7440224	6.00E-05	N/F	1.80E+01	1.50E-04	1.50E-04	3.00E-04	3.00E-04	6.00E-04	6.00E-04
TBTO	56359	2.00E-06	7.00E+01	N/S	5.00E-06	5.00E-06	1.00E-05	1.00E-05	2.00E-05	2.00E-05
Tetrachlorethane (1,1,2,2)	79345	1.08E-02	1.45E+03	N/S	2.70E-02	2.70E-02	5.40E-02	5.40E-02	1.08E-01	1.08E-01
Tetrachlorethylene	127184	8.85E-03	1.00E+02	7.00E-01	2.21E-02	2.21E-02	4.43E-02	4.43E-02	8.85E-02	8.85E-02
Thallium	7440280	6.30E-03	N/F	N/S	1.58E-02	1.58E-02	3.15E-02	3.15E-02	6.30E-02	6.30E-02
Toluene	108883	1.10E-02	2.68E+02	1.00E+03	2.75E-02	2.75E-02	5.50E-02	5.50E-02	1.10E-01	1.10E-01
Toxaphene	8001352	2.00E-07	2.50E-04	3.10E-02	5.00E-07	5.00E-07	1.00E-06	1.00E-06	2.00E-06	2.00E-06
Trichloroethane 1,1,2	79005	4.20E-02	2.25E+03	N/S	1.05E-01	1.05E-01	2.10E-01	2.10E-01	4.20E-01	4.20E-01
Trichloroethylene	79016	9.24E-02	5.50E+02	2.80E+00	2.31E-01	2.31E-01	4.62E-01	4.62E-01	9.24E-01	9.24E-01
Trichlorophenol 2,4,6	88062	6.50E-03	4.00E+02	N/S	1.63E-02	1.63E-02	3.25E-02	3.25E-02	6.50E-02	6.50E-02
Vinyl chloride	75014	5.25E-01	5.50E-01	1.50E-02	1.31E+00	1.50E-02	2.63E+00	1.50E-02	5.25E+00	1.50E-02
Xylenes, total	1330000	8.00E-01	8.55E+01	5.30E+02	2.00E+00	2.00E+00	4.00E+00	4.00E+00	8.00E+00	8.00E+00
Zinc	7440666	5.00E-02	N/F	2.10E+03	1.25E-01	1.25E-01	2.50E-01	2.50E-01	5.00E-01	5.00E-01

* The criteria to determine Method I G-3 target concentrations can be found in Appendix 6.

** All units are in Milligrams per Liter

** If the distance from the plume's leading edge (PLE) to the nearest surface water body is < 250 feet, G3 Method II must be used. If this distance is >= 250 ft and < 500 ft then the values in the Target Concentrations 250 ft column should be used. If the distance is >= 500 ft and < 1000 ft then the values in the Target Concentrations 500 ft column should be used. If the distance is >=1000 ft, then the values in the Target Concentrations 1000 ft column should be used.

N/S - No Standard Available

N/F - Not Found

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Acephate	30560191	4.00E-03	8.70E-03	73	Cancer Risk		73	Cancer Risk
Acetochlor	34256821	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Acetone	67641	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Acetone cyanohydrin	75865	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Acetonitrile	75078	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
Acetophenone	98862	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Acifluorfen	62476599	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Acrolein	107028	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Acrylamide	79061	2.00E-04	4.50E+00	0.14	Cancer Risk		0.14	Cancer Risk
Acrylic acid	79107	5.00E-01		39000	Noncancer Risk	7800	7800	Noncancer Risk
Acrylonitrile	107131	1.00E-03	5.40E-01	1.2	Cancer Risk		1.2	Cancer Risk
Alachlor	15972608	1.00E-02	8.00E-02	8	Cancer Risk		8	Cancer Risk
Alar	1596845	1.50E-01		12000	Noncancer Risk	2400	2400	Noncancer Risk
Aldicarb	116063	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Aldicarb sulfone	1646884	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Aldrin	309002	3.00E-05	1.70E+01	0.038	Cancer Risk		0.038	Cancer Risk
Alkanes (**)								
C_5-C_8		6.00E-02		4693	Noncancer Risk	938.6	938.6	Noncancer Risk
C_9-C_{18}		6.00E-01		46930	Noncancer Risk	9386	9386	Noncancer Risk
C_{19}-C_{32}		6.00E+00		469300	Noncancer Risk	93860	93860	Noncancer Risk
Ally	74223646	2.50E-01		20000	Noncancer Risk	4000	4000	Noncancer Risk
Allyl alcohol	107186	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Allyl chloride	107051	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Aluminum	7429905	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Aluminum phosphide	20859738	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Amdro	67485294	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Ametryn	834128	9.00E-03		700	Noncancer Risk	140	140	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
m-Aminophenol	591275	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
4-Aminopyridine	504245	2.00E-05		1.6	Noncancer Risk	0.32	0.32	Noncancer Risk
Amitraz	33089611	2.50E-03		200	Noncancer Risk	40	40	Noncancer Risk
Ammonium sulfamate	7773060	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Aniline	62533		5.70E-03	110	Cancer Risk		110	Cancer Risk
Antimony and compounds	7440360	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Antimony pentoxide	1314609	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
Antimony potassium tartrate	304610	9.00E-04		70	Noncancer Risk	14	14	Noncancer Risk
Antimony tetroxide	1332316	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Antimony trioxide	1309644	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Apollo	74115245	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Aramite	140578	5.00E-02	2.50E-02	26	Cancer Risk		26	Cancer Risk
Aromatics C_9-C_{32} (**)		3.00E-02		2346	Noncancer Risk	469.2	469.2	Noncancer Risk
Arsenic	7440382	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Arsenic (as carcinogen)	7440382		1.50E+00	0.43	Cancer Risk		0.43	Cancer Risk
Assure	76578148	9.00E-03		700	Noncancer Risk	140	140	Noncancer Risk
Asulam	3337711	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Atrazine	1912249	3.50E-02	2.22E-01	2.9	Cancer Risk		2.9	Cancer Risk
Avermectin B1	65195553	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Azobenzene	103333		1.10E-01	5.8	Cancer Risk		5.8	Cancer Risk
Barium and compounds	7440393	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Baygon	114261	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
Bayleton	43121433	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Baythroid	68359375	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Benefin	1861401	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Benomyl	17804352	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Bentazon	25057890	2.50E-03		200	Noncancer Risk	40	40	Noncancer Risk
Benzaldehyde	100527	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Benzene	71432		2.90E-02	22	Cancer Risk		22	Cancer Risk
Benzenethiol	108985	1.00E-05		0.78	Noncancer Risk	0.156	0.156	Noncancer Risk
Benzidine	92875	3.00E-03	2.30E+02	0.0028	Cancer Risk		0.0028	Cancer Risk
Benzoic acid	65850	4.00E+00		310000	Noncancer Risk	62000	62000	Noncancer Risk
Benzotrichloride	98077		1.30E+01	0.049	Cancer Risk		0.049	Cancer Risk
Benzyl alcohol	100516	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Benzyl chloride	100447		1.70E-01	3.8	Cancer Risk		3.8	Cancer Risk
Beryllium and compounds	7440417	5.00E-03	4.30E+00	0.15	Cancer Risk		0.15	Cancer Risk
Bidrin	141662	1.00E-04		7.8	Noncancer Risk	1.56	1.56	Noncancer Risk
Biphenthrin (Talstar)	82657043	1.50E-02		1200	Noncancer Risk	240	240	Noncancer Risk
1,1-Biphenyl	92524	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Bis(2-chloroethyl)ether	111444		1.10E+00	0.58	Cancer Risk		0.58	Cancer Risk
Bis(2-chloroisopropyl)ether	39638329	4.00E-02	7.00E-02	9.1	Cancer Risk		9.1	Cancer Risk
Bis(chloromethyl)ether	542881		2.20E+02	0.0029	Cancer Risk		0.0029	Cancer Risk
Bis(2-chloro-1-methylethyl)ether			7.00E-02	9.1	Cancer Risk		9.1	Cancer Risk
Bis(2-ethylhexyl)phthalate (DEHP)	117817	2.00E-02	1.40E-02	46	Cancer Risk		46	Cancer Risk
Bisphenol A	80057	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Boron (and borates)	7440428	9.00E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
Bromodichloromethane	75274	2.00E-02	6.20E-02	10	Cancer Risk		10	Cancer Risk
Bromoform (tribromomethane)	75252	2.00E-02	7.90E-03	81	Cancer Risk		81	Cancer Risk
Bromomethane	74839	1.40E-03		110	Noncancer Risk	22	22	Noncancer Risk
4-Bromophenyl phenyl ether	101553	5.80E-02		4500	Noncancer Risk	900	900	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Bromophos	2104963	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Bromoxynil	1689845	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Bromoxynil octanoate	1689992	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
1-Butanol	71363	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Butyl benzyl phthalate	85687	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Butylate	2008415	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
sec-Butylbenzene	135988	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
tert-Butylbenzene	104518	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Butylphthalyl butylglycolate	85701	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Cacodylic acid	75605	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Cadmium and compounds	7440439	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
Caprolactam	105602	5.00E-01		39000	Noncancer Risk	7800	7800	Noncancer Risk
Captafol	2425061	2.00E-03	8.60E-03	74	Cancer Risk		74	Cancer Risk
Captan	133062	1.30E-01	3.50E-03	180	Cancer Risk		180	Cancer Risk
Carbaryl	63252	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Carbofuran	1563662	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Carbon disulfide	75150	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Carbon tetrachloride	56235	7.00E-04	1.30E-01	4.9	Cancer Risk		4.9	Cancer Risk
Carbosulfan	55285148	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Carboxin	5234684	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Chloral	75876	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Chloramben	133904	1.50E-02		1200	Noncancer Risk	240	240	Noncancer Risk
Chloranil	118752		4.03E-01	1.6	Cancer Risk		1.6	Cancer Risk
Chlordane	57749	6.00E-05	1.30E+00	0.49	Cancer Risk		0.49	Cancer Risk
Chlorimuron-ethyl	90982324	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Chlorine	7782505	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Chlorine cyanide	506774	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Chloroacetaldehyde	107200	6.90E-03		540	Noncancer Risk	108	108	Noncancer Risk
Chloroacetic acid	79118	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
4-Chloroaniline	106478	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
Chlorobenzene	108907	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Chlorobenzilate	510156	2.00E-02	2.70E-01	2.4	Cancer Risk		2.4	Cancer Risk
p-Chlorobenzoic acid	74113	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
4-Chlorobenzotrifluoride	98566	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
2-Chloro-1,3-butadiene	126998	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
1-Chlorobutane	109693	4.00E-01		31000	Noncancer Risk	6200	6200	Noncancer Risk
Chlorodibromomethane	124481	2.00E-02	8.40E-02	7.6	Cancer Risk		7.6	Cancer Risk
Chloroethane	75003	4.00E-01		31000	Noncancer Risk	6200	6200	Noncancer Risk
2-Chloroethyl vinyl ether	110758	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Chloroform	67663	1.00E-02	6.10E-03	100	Cancer Risk		100	Cancer Risk
Chloromethane	74873		1.30E-02	49	Cancer Risk		49	Cancer Risk
4-Chloro-2,2-methylaniline hydrochloride	3165933		4.60E-01	1.4	Cancer Risk		1.4	Cancer Risk
4-Chloro-2-methylaniline	95692		5.80E-01	1.1	Cancer Risk		1.1	Cancer Risk
beta-Chloronaphthalene	91587	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
o-Chloronitrobenzene	88733		2.50E-02	26	Cancer Risk		26	Cancer Risk
p-Chloronitrobenzene	100005		1.80E-02	35	Cancer Risk		35	Cancer Risk
2-Chlorophenol	95578	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Chlorothalonil	1897456	1.50E-02	1.10E-02	58	Cancer Risk		58	Cancer Risk
o-Chlorotoluene	95498	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Chlorpropham	101213	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Chlorpyrifos	2921882	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Chlorpyrifos-methyl	5598130	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Chlorsulfuron	64902723	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Chlorthiophos	60238564	8.00E-04		63	Noncancer Risk	12.6	12.6	Noncancer Risk
Chromium III and compounds	16065831	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Chromium VI and compounds.	18540299	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Cobalt	7440484	6.00E-02		4700	Noncancer Risk	940	940	Noncancer Risk
Copper and compounds	7440508	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Crotonaldehyde	123739	1.00E-02	1.90E+00	0.34	Cancer Risk		0.34	Cancer Risk
Cumene	98828	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Cyanides:								
Barium cyanide	542621	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Calcium cyanide	592018	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Copper cyanide	544923	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Cyanazine	21725462	2.00E-03	8.40E-01	0.76	Cancer Risk		0.76	Cancer Risk
Cyanogen	460195	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Cyanogen bromide	506683	9.00E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
Cyanogen chloride	506774	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Free cyanide	57125	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Hydrogen cyanide	74908	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Potassium cyanide	151508	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Potassium silver cyanide	506616	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Silver cyanide	506649	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Sodium cyanide	143339	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Thiocyanate		2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Zinc cyanide	557211	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Cyclohexanone	108941	5.00E+00		390000	Noncancer Risk	78000	78000	Noncancer Risk
Cyclohexlamine	108918	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Cyhalothrin/Karate	68085858	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Cypermethrin	52315078	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Cyromazine	66215278	7.50E-03		590	Noncancer Risk	118	118	Noncancer Risk
Dacthal	1861321	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Dalapon	75990	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Danitol	39515418	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
DDD	72548		2.40E-01	2.7	Cancer Risk		2.7	Cancer Risk
DDE	72559		3.40E-01	1.9	Cancer Risk		1.9	Cancer Risk
DDT	50293	5.00E-04	3.40E-01	1.9	Cancer Risk		1.9	Cancer Risk
Decabromodiphenyl ether	1163195	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Demeton	8065483	4.00E-05		3.1	Noncancer Risk	0.62	0.62	Noncancer Risk
Diallate	2303164		6.10E-02	10	Cancer Risk		10	Cancer Risk
Diazinon	333415	9.00E-04		70	Noncancer Risk	14	14	Noncancer Risk
Dibenzofuran	132649	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
1,4-Dibromobenzene	106376	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
1,2-Dibromo-3-chloropropane	96128		1.40E+00	0.46	Cancer Risk		0.46	Cancer Risk
1,2-Dibromoethane	106934		8.50E+01	0.0075	Cancer Risk		0.0075	Cancer Risk
Dibutyl phthalate	84742	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Dicamba	1918009	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
1,2-Dichlorobenzene	95501	9.00E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
1,3-Dichlorobenzene	541731	8.90E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
1,4-Dichlorobenzene	106467		2.40E-02	27	Cancer Risk		27	Cancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
3,3'-Dichlorobenzidine	91941		4.50E-01	1.4	Cancer Risk		1.4	Cancer Risk
Dichlorodifluoromethane	75718	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
1,1-Dichloroethane	75343	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
1,2-Dichloroethane (EDC)	107062		9.10E-02	7	Cancer Risk		7	Cancer Risk
1,1-Dichloroethylene	75354	9.00E-03	6.00E-01	1.1	Cancer Risk		1.1	Cancer Risk
1,2-Dichloroethylene (cis)	156592	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
1,2-Dichloroethylene (trans)	156605	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
1,2-Dichloroethylene (mixture)	540590	9.00E-03		700	Noncancer Risk	140	140	Noncancer Risk
2,4-Dichlorophenol	120832	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
2,4-Dichlorophenoxyacetic Acid (2, 4-D)	94757	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
4-(2,4-Dichlorophenoxy)butyric Acid	94826	8.00E-03		630	Noncancer Risk	126	126	Noncancer Risk
1,2-Dichloropropane	78875		6.80E-02	9.4	Cancer Risk		9.4	Cancer Risk
2,3-Dichloropropanol	616239	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
1,3-Dichloropropene	542756	3.00E-04	1.75E-01	3.7	Cancer Risk		3.7	Cancer Risk
Dichlorvos	62737	5.00E-04	2.90E-01	2.2	Cancer Risk		2.2	Cancer Risk
Dicofol	115322		4.40E-01	1.5	Cancer Risk		1.5	Cancer Risk
Dicyclopentadiene	77736	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Dieldrin	60571	5.00E-05	1.60E+01	0.04	Cancer Risk		0.04	Cancer Risk
Diethyl phthalate	84662	8.00E-01		63000	Noncancer Risk	12600	12600	Noncancer Risk
Diethylene glycol, monoethyl ether	111900	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Diethylforamide	617845	1.10E-02		860	Noncancer Risk	172	172	Noncancer Risk
Di(2-ethylhexyl)adipate	103231	6.00E-01	1.20E-03	530	Cancer Risk		530	Cancer Risk
Diethylstilbestrol	56531		4.70E+03	0.00014	Cancer Risk		0.00014	Cancer Risk
Difenzoquat (Avenge)	43222486	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
Diflubenzuron	35367385	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Diisopropyl methylphosphonate (DIMP)	1445756	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
Dimethipin	55290647	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Dimethoate	60515	2.00E-04		16	Noncancer Risk	3.2	3.2	Noncancer Risk
3,3'-Dimethoxybenzidine	119904		1.40E-02	46	Cancer Risk		46	Cancer Risk
2,4-Dimethylaniline hydrochloride	21436964		5.80E-01	1.1	Cancer Risk		1.1	Cancer Risk
2,4-Dimethylaniline	95681		7.50E-01	0.85	Cancer Risk		0.85	Cancer Risk
N-N-Dimethylaniline	121697	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
3,3'-Dimethylbenzidine	119937		9.20E+00	0.069	Cancer Risk		0.069	Cancer Risk
N,N-Dimethylformamide	68122	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
1,1-Dimethylhydrazine	57147		2.60E+00	0.25	Cancer Risk		0.25	Cancer Risk
1,2-Dimethylhydrazine	540738		3.70E+01	0.017	Cancer Risk		0.017	Cancer Risk
2,4-Dimethylphenol	105679	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
2,6-Dimethylphenol	576261	6.00E-04		47	Noncancer Risk	9.4	9.4	Noncancer Risk
3,4-Dimethylphenol	95658	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Dimethyl phthalate	131113	1.00E+01		780000	Noncancer Risk	156000	156000	Noncancer Risk
Dimethyl terephthalate	120616	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
1,2-Dinitrobenzene	528290	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
1,3-Dinitrobenzene	99650	1.00E-04		7.8	Noncancer Risk	1.56	1.56	Noncancer Risk
1,4-Dinitrobenzene	100254	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
4,6-Dinitro-o-cyclohexyl phenol	131895	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
2,4-Dinitrophenol	51285	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Dinitrotoluene mixture			6.80E-01	0.94	Cancer Risk		0.94	Cancer Risk
2,4-Dinitrotoluene	121142	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
2,6-Dinitrotoluene	606202	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Dinoseb	88857	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
di-n-Octyl phthalate	117840	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
1,4-Dioxane	123911		1.10E-02	58	Cancer Risk		58	Cancer Risk
Dioxins and Furans (**)								
2,3,7,8-HpCDD				0.00041	Cancer Risk		0.00041	Cancer Risk
2,3,7,8-HpCDF				0.00041	Cancer Risk		0.00041	Cancer Risk
2,3,7,8-HxCDD				0.000041	Cancer Risk		0.000041	Cancer Risk
2,3,7,8-HxCDF				0.000041	Cancer Risk		0.000041	Cancer Risk
OCDD	3268879			0.0041	Cancer Risk		0.0041	Cancer Risk
OCDF				0.0041	Cancer Risk		0.0041	Cancer Risk
2,3,7,8-PeCDD				8.20E-06	Cancer Risk		8.2E-06	Cancer Risk
1,2,3,7,8-PeCDF	57117416			8.20E-05	Cancer Risk		8.2E-05	Cancer Risk
2,3,4,7,8-PeCDF	57117314			8.20E-06	Cancer Risk		0.0000082	Cancer Risk
2,3,7,8-TCDD (dioxin)	1746016		1.56E+05	4.10E-06	Cancer Risk		4.1E-06	Cancer Risk
2,3,7,8-TCDF	51207319			0.000041	Cancer Risk		0.000041	Cancer Risk
Diphenamid	957517	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Diphenylamine	122394	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
1,2-Diphenylhydrazine	122667		8.00E-01	0.8	Cancer Risk		0.8	Cancer Risk
Diquat	85007	2.20E-03		170	Noncancer Risk	34	34	Noncancer Risk
Direct black 38	1937377		8.60E+00	0.074	Cancer Risk		0.074	Cancer Risk
Direct blue 6	2602462		8.10E+00	0.079	Cancer Risk		0.079	Cancer Risk
Direct brown 95	16071866		9.30E+00	0.069	Cancer Risk		0.069	Cancer Risk
Disulfoton	298044	4.00E-05		3.1	Noncancer Risk	0.62	0.62	Noncancer Risk
1,4-Dithiane	505293	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Diuron	330541	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Dodine	2439103	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Eicosane (**)		6.00E+00		469300	Noncancer Risk	93860	93860	Noncancer Risk
Endosulfan	115297	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
Endothall	145733	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Endrin	72208	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Epichlorohydrin	106898	2.00E-03	9.90E-03	65	Cancer Risk		65	Cancer Risk
Ethephon (2-chloroethyl phosphonic acid)	16672870	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Ethion	563122	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
2-Ethoxyethanol acetate	111159	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
2-Ethoxyethanol	110805	4.00E-01		31000	Noncancer Risk	6200	6200	Noncancer Risk
Ethyl acrylate	140885		4.80E-02	13	Cancer Risk		13	Cancer Risk
EPTC (S-Ethyl dipropylthiocarbamate)	759944	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Ethyl acetate	141786	9.00E-01		70000	Noncancer Risk	14000	14000	Noncancer Risk
Ethylbenzene	100414	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Ethylene cyanohydrin	109784	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Ethylene diamine	107153	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Ethylene glycol	107211	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Ethylene oxide	75218		1.02E+00	0.63	Cancer Risk		0.63	Cancer Risk
Ethylene thiourea (ETU)	96457	8.00E-05	1.19E-01	5.4	Cancer Risk		5.4	Cancer Risk
Ethyl ether	60297	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Ethyl methacrylate	97632	9.00E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
Ethyl p-nitrophenyl phenylphosphorothioate	2104645	1.00E-05		0.78	Noncancer Risk	0.156	0.156	Noncancer Risk
Ethylnitrosourea	759739		1.40E+02	0.0046	Cancer Risk		0.0046	Cancer Risk
Ethylphthalyl ethyl glycolate	84720	3.00E+00		230000	Noncancer Risk	46000	46000	Noncancer Risk
Express	10120	8.00E-03		630	Noncancer Risk	126	126	Noncancer Risk
Fenamiphos	22224926	2.50E-04		20	Noncancer Risk	4	4	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Fluometuron	2164172	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Fluoride	7782414	6.00E-02		4700	Noncancer Risk	940	940	Noncancer Risk
Fluoridone	59756604	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
Flurprimidol	56425913	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Flutolanil	66332965	6.00E-02		4700	Noncancer Risk	940	940	Noncancer Risk
Fluvalinate	69409945	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Folpet	133073	1.00E-01	3.50E-03	180	Cancer Risk		180	Cancer Risk
Fomesafen	72178020		1.90E-01	3.4	Cancer Risk		3.4	Cancer Risk
Fonofos	944229	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Formaldehyde	50000	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Formic Acid	64186	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Fosetyl-al	39148248	3.00E+00		230000	Noncancer Risk	46000	46000	Noncancer Risk
Furan	110009	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Furazolidone	67458		3.80E+00	0.17	Cancer Risk		0.17	Cancer Risk
Furfural	98011	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Furium	531828		5.00E+01	0.013	Cancer Risk		0.013	Cancer Risk
Furmecyclox	60568050		3.00E-02	21	Cancer Risk		21	Cancer Risk
Glufosinate-ammonium	77182822	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Glycidaldehyde	765344	4.00E-04		31	Noncancer Risk	6.2	6.2	Noncancer Risk
Glyphosate	1071836	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Haloxyfop-methyl	69806402	5.00E-05		3.9	Noncancer Risk	0.78	0.78	Noncancer Risk
Harmony	79277273	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
HCH (alpha)	319846		6.30E+00	0.1	Cancer Risk		0.1	Cancer Risk
HCH (beta)	319857		1.80E+00	0.35	Cancer Risk		0.35	Cancer Risk
HCH (gamma) Lindane	58899	3.00E-04	1.30E+00	0.49	Cancer Risk		0.49	Cancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
HCH-technical	608731		1.80E+00	0.35	Cancer Risk		0.35	Cancer Risk
Heptachlor	76448	5.00E-04	4.50E+00	0.14	Cancer Risk		0.14	Cancer Risk
Heptachlor epoxide	1024573	1.30E-05	9.10E+00	0.07	Cancer Risk		0.07	Cancer Risk
Hexabromobenzene	87821	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Hexachlorobenzene	118741	8.00E-04	1.60E+00	0.4	Cancer Risk		0.4	Cancer Risk
Hexachlorobutadiene	87683	2.00E-04	7.80E-02	8.2	Cancer Risk		8.2	Cancer Risk
Hexachlorocyclopentadiene	77474	7.00E-03		550	Noncancer Risk	110	110	Noncancer Risk
Hexachlorodibenzo-p-dioxin mixture	19408743		6.20E+03	0.0001	Cancer Risk		0.0001	Cancer Risk
Hexachloroethane	67721	1.00E-03	1.40E-02	46	Cancer Risk		46	Cancer Risk
Hexachlorophene	70304	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121824	3.00E-03	1.10E-01	5.8	Cancer Risk		5.8	Cancer Risk
n-Hexane (**)	110543	6.00E-02		4693	Noncancer Risk	938.6	938.6	Noncancer Risk
Hexazinone	51235042	3.30E-02		2600	Noncancer Risk	520	520	Noncancer Risk
Hydrazine, hydrazine sulfate	302012		3.00E+00	0.21	Cancer Risk		0.21	Cancer Risk
Hydrogen sulfide	7783064	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Hydroquinone	123319	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Imazalil	35554440	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Imazaquin	81335377	2.50E-01		20000	Noncancer Risk	4000	4000	Noncancer Risk
Iprodione	36734197	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Iron	7439896	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Isobutanol	78831	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Isophorone	78591	2.00E-01	9.50E-04	670	Cancer Risk		670	Cancer Risk
Isopropalin	33820530	1.50E-02		1200	Noncancer Risk	240	240	Noncancer Risk
Isopropyl methyl phosphonic acid	1832548	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Isoxaben	82558507	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Kepone	143500		1.80E+01	0.035	Cancer Risk		0.035	Cancer Risk
Lactofen	77501634	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Lead (**)	7439921			400	Noncancer Risk	400	400	Noncancer Risk
Linuron	330552	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Lithium	7439932	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Londax	83056996	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Malathion	121755	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Maleic anhydride	108316	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Maleic hydrazide	123331	5.00E-01		39000	Noncancer Risk	7800	7800	Noncancer Risk
Malononitrile	109773	2.00E-05		1.6	Noncancer Risk	0.32	0.32	Noncancer Risk
Mancozeb	8018017	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Maneb	12427382	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Manganese and compounds	7439965	2.30E-02		1800	Noncancer Risk	360	360	Noncancer Risk
Mephosfolan	950107	9.00E-05		7	Noncancer Risk	1.4	1.4	Noncancer Risk
Mepiquat chloride	24307264	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Mercuric chloride	7487947	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Mercury (inorganic)	7439976	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Mercury (methyl)	22967926	1.00E-04		7.8	Noncancer Risk	1.56	1.56	Noncancer Risk
Merphos	150505	3.00E-05		2.3	Noncancer Risk	0.46	0.46	Noncancer Risk
Merphos oxide	78488	3.00E-05		2.3	Noncancer Risk	0.46	0.46	Noncancer Risk
Metalaxyl	57837191	6.00E-02		4700	Noncancer Risk	940	940	Noncancer Risk
Methacrylonitrile	126987	1.00E-04		7.8	Noncancer Risk	1.56	1.56	Noncancer Risk
Methamidophos	10265926	5.00E-05		3.9	Noncancer Risk	0.78	0.78	Noncancer Risk
Methanol	67561	5.00E-01		39000	Noncancer Risk	7800	7800	Noncancer Risk
Methidathion	950378	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Methomyl	16752775	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Methoxychlor	72435	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
2-Methoxyethanol acetate	110496	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
2-Methoxyethanol	109864	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
2-Methoxy-5-nitroaniline	99592		4.60E-02	14	Cancer Risk		14	Cancer Risk
Methyl acetate	79209	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Methyl acrylate	96333	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
2-Methylaniline hydrochloride	636215		1.80E-01	3.5	Cancer Risk		3.5	Cancer Risk
2-Methylaniline	95534		2.40E-01	2.7	Cancer Risk		2.7	Cancer Risk
Methyl chlorocarbonate	79221	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
4-(2-Methyl-4-chlorophenoxy) butyric acid	94815	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
2-Methyl-4-chlorophenoxyacetic acid	94746	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
2-(2-Methyl-14-chlorophenoxy)propionic acid	93652	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Methylene bromide	74953	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Methylene chloride	75092	6.00E-02	7.50E-03	85	Cancer Risk		85	Cancer Risk
4,4'-Methylene bis(2-chloroaniline)	101144	7.00E-04	1.30E-01	4.9	Cancer Risk		4.9	Cancer Risk
4,4'-Methylenebisbenzeneamine	101779		2.50E-01	2.6	Cancer Risk		2.6	Cancer Risk
4,4'-Methylene bis(N,N'-dimethyl)aniline	101611		4.60E-02	14	Cancer Risk		14	Cancer Risk
Methyl ethyl ketone	78933	6.00E-01		47000	Noncancer Risk	9400	9400	Noncancer Risk
Methyl hydrazine	60344		1.10E+00	0.58	Cancer Risk		0.58	Cancer Risk
Methyl isobutyl ketone	108101	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
Methyl methacrylate	80626	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
2-Methyl-5-nitroaniline	99558		3.30E-02	19	Cancer Risk		19	Cancer Risk
Methyl parathion	298000	2.50E-04		20	Noncancer Risk	4	4	Noncancer Risk
2-Methylphenol (o-cresol)	95487	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
3-Methylphenol (m-cresol)	103394	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
4-Methylphenol (p-cresol)	106445	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Methyl styrene (mixture)	25013154	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
Methyl styrene (alpha)	98839	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Methyl tertbutyl ether (MTBE)	1634044	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Metolaclor (Dual)	51218452	1.50E-01		12000	Noncancer Risk	2400	2400	Noncancer Risk
Metribuzin	21087649	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Mirex	2385855	2.00E-04	1.80E+00	0.35	Cancer Risk		0.35	Cancer Risk
Molinate	2212671	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Molybdenum	7439987	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Monochloramine	10599903	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Naled	300765	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
2-Naphthylamine	91598		1.30E+02	0.0049	Cancer Risk		0.0049	Cancer Risk
Napropamide	15299997	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Nickel and compounds	7440020	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Nitrapyrin	1929824	1.50E-03		120	Noncancer Risk	24	24	Noncancer Risk
Nitrate	14797558	1.60E+00		130000	Noncancer Risk	26000	26000	Noncancer Risk
Nitric Oxide	10102439	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
Nitrite	14797650	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
2-Nitroaniline	88744	6.00E-05		4.7	Noncancer Risk	0.94	0.94	Noncancer Risk
3-Nitroaniline	99092	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
4-Nitroaniline	100016	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Nitrobenzene	98953	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
Nitrofurantoin	67209	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Nitrofurazone	59870		1.50E+00	0.43	Cancer Risk		0.43	Cancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Nitrogen dioxide	10102440	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Nitroguanidine	556887	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
4-Nitrophenol	100027	6.20E-02		4800	Noncancer Risk	960	960	Noncancer Risk
N-Nitrosodi-n-butylamine	924163		5.40E+00	0.12	Cancer Risk		0.12	Cancer Risk
N-Nitrosodiethanolamine	1116547		2.80E+00	0.23	Cancer Risk		0.23	Cancer Risk
N-Nitrosodiethylamine	55185		1.50E+02	0.0043	Cancer Risk		0.0043	Cancer Risk
N-Nitrosodimethylamine	62759		5.10E+01	0.013	Cancer Risk		0.013	Cancer Risk
N-Nitrosodiphenylamine	86306		4.90E-03	130	Cancer Risk		130	Cancer Risk
N-Nitroso di-n-propylamine	621647		7.00E+00	0.091	Cancer Risk		0.091	Cancer Risk
N-Nitroso-N-methylethylamine	10595956		2.20E+01	0.029	Cancer Risk		0.029	Cancer Risk
N-Nitrosopyrrolidine	930552		2.10E+00	0.3	Cancer Risk		0.3	Cancer Risk
m-Nitrotoluene	99081	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
o-Nitrotoluene	88722	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
p-Nitrotoluene	99990	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
n-Nonane (**)	111842	6.00E-01		46930	Noncancer Risk	9386	9386	Noncancer Risk
Norflurazon	27314132	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
NuStar	85509199	7.00E-04		55	Noncancer Risk	11	11	Noncancer Risk
Octabromodiphenyl ether	32536520	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Octahydro-1357-tetranitro-1357-tetrazocine	2691410	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Octamethylpyrophosphoramide	152169	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Oryzalin	19044883	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Oxadiazon	19666309	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Oxamyl	23135220	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Oxyfluorfen	42874033	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Paclobutrazol	76738620	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Paraquat	1910425	4.50E-03		350	Noncancer Risk	70	70	Noncancer Risk
Parathion	56382	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
Pebulate	1114712	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Pendimethalin	40487421	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Pentabromo-6-chloro cyclohexane	87843		2.30E-02	28	Cancer Risk		28	Cancer Risk
Pentabromodiphenyl ether	32534819	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Pentachlorobenzene	608935	8.00E-04		63	Noncancer Risk	12.6	12.6	Noncancer Risk
Pentachloronitrobenzene	82688	3.00E-03	2.60E-01	2.5	Cancer Risk		2.5	Cancer Risk
Pentachlorophenol	87865	3.00E-02	1.20E-01	5.3	Cancer Risk		5.3	Cancer Risk
Permethrin	52645531	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Phenmedipham	13684634	2.50E-01		20000	Noncancer Risk	4000	4000	Noncancer Risk
Phenol	108952	6.00E-01		47000	Noncancer Risk	9400	9400	Noncancer Risk
m-Phenylenediamine	108452	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
p-Phenylenediamine	106503	1.90E-01		15000	Noncancer Risk	3000	3000	Noncancer Risk
Phenylmercuric acetate	62384	8.00E-05		6.3	Noncancer Risk	1.26	1.26	Noncancer Risk
2-Phenylphenol	90437		1.94E-03	330	Cancer Risk		330	Cancer Risk
Phorate	298022	2.00E-04		16	Noncancer Risk	3.2	3.2	Noncancer Risk
Phosmet	732116	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Phosphine	7803512	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Phosphorus (white)	7723140	2.00E-05		1.6	Noncancer Risk	0.32	0.32	Noncancer Risk
p-Phthalic acid	100210	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Phthalic anhydride	85449	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Picloram	1918021	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Pirimiphos-methyl	29232937	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
Polybrominated biphenyls		7.00E-06	8.90E+00	0.072	Cancer Risk		0.072	Cancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Polychlorinated biphenyls (PCBs)	1336363		7.70E+00	0.083	Cancer Risk		0.083	Cancer Risk
Aroclor 1016	12674112	7.00E-05		5.5	Noncancer Risk	1.1	1.1	Noncancer Risk
Aroclor 1254	11097691	2.00E-05		1.6	Noncancer Risk	0.32	0.32	Noncancer Risk
Polychlorinated terphenyls (PCTs)			4.50E+00	0.14	Cancer Risk		0.14	Cancer Risk
Polynuclear aromatic hydrocarbons					Noncancer Risk			
Acenaphthene	83329	6.00E-02		4700	Noncancer Risk	940	940	Noncancer Risk
Anthracene	120127	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Benz[a]anthracene	56553		7.30E-01	0.88	Cancer Risk		0.88	Cancer Risk
Benzo[b]fluoranthene	205992		7.30E-01	0.88	Cancer Risk		0.88	Cancer Risk
Benzo[k]fluoranthene	207089		7.30E-02	8.8	Cancer Risk		8.8	Cancer Risk
Benzo[a]pyrene	50328		7.30E+00	0.088	Cancer Risk		0.088	Cancer Risk
Carbazole	86748		2.00E-02	32	Cancer Risk		32	Cancer Risk
Chrysene	218019		7.30E-03	88	Cancer Risk		88	Cancer Risk
Dibenz[ah]anthracene	53703		7.30E+00	0.088	Cancer Risk		0.088	Cancer Risk
Fluoranthene	206440	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Fluorene	86737	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Indeno[1,2,3-cd]pyrene	193395		7.30E-01	0.88	Cancer Risk		0.88	Cancer Risk
Naphthalene	91203	4.00E-02		3100	Noncancer Risk	620	620	Noncancer Risk
Pyrene (**)	129000	3.00E-02		2346	Noncancer Risk	469.2	469.2	Noncancer Risk
Prochloraz	67747095	9.00E-03	1.50E-01	4.3	Cancer Risk		4.3	Cancer Risk
Profluralin	26399360	6.00E-03		470	Noncancer Risk	94	94	Noncancer Risk
Prometon	1610180	1.50E-02		1200	Noncancer Risk	240	240	Noncancer Risk
Prometryn	7287196	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
Pronamide	23950585	7.50E-02		5900	Noncancer Risk	1180	1180	Noncancer Risk
Propachlor	1918167	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*) (mg/kg-d)	ORAL SLOPE FACTOR (*) (mg/kg-d)-1	EPA REGION III RISK-BASED CONC. (mg/kg)	EPA REGION III RISK-BASED CONC. Basis	EPA REGION III NONCANCER RISK-BASED CONC. x 0.2 (HQ)	METHOD I S-1 TARGET CONCENTRATIONS (mg/kg)	METHOD I S-1 TARGET CONCENTRATIONS Basis
Propanil	709988	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Propargite	2312358	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Propargyl alcohol	107197	2.00E-03		160	Noncancer Risk	32	32	Noncancer Risk
Propazine	139402	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Propham	122429	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Propiconazole	60207901	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Propylene glycol	57556	2.00E+01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Propylene glycol, monoethyl ether	52125538	7.00E-01		55000	Noncancer Risk	11000	11000	Noncancer Risk
Propylene glycol, monomethyl ether	107982	7.00E-01		55000	Noncancer Risk	11000	11000	Noncancer Risk
Propylene oxide	75569		2.40E-01	2.7	Cancer Risk		2.7	Cancer Risk
Pursuit	81335775	2.50E-01		20000	Noncancer Risk	4000	4000	Noncancer Risk
Pydrin	51630581	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Pyridine	110861	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Quinalphos	13593038	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
Quinoline	91225		1.20E+01	0.053	Cancer Risk		0.053	Cancer Risk
Resmethrin	10463868	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Ronnel	299843	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Rotenone	83794	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
Savey	78587050	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Selenious Acid	7783008	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Selenium	7782492	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Selenourea	630104	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Sethoxydim	74051802	9.00E-02		7000	Noncancer Risk	1400	1400	Noncancer Risk
Silver and compounds	7440224	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Simazine	122349	5.00E-03	1.20E-01	5.3	Cancer Risk		5.3	Cancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Sodium azide	26628228	4.00E-03		310	Noncancer Risk	62	62	Noncancer Risk
Sodium diethyldithiocarbamate	148185	3.00E-02	2.70E-01	2.4	Cancer Risk		2.4	Cancer Risk
Sodium fluoroacetate	62748	2.00E-05		1.6	Noncancer Risk	0.32	0.32	Noncancer Risk
Sodium metavanadate	13718268	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Strontium, stable	7440246	6.00E-01		47000	Noncancer Risk	9400	9400	Noncancer Risk
Strychnine	57249	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Styrene	100425	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Systhane	88671890	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk
Tebuthiuron	34014181	7.00E-02		5500	Noncancer Risk	1100	1100	Noncancer Risk
Temephos	3383968	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Terbacil	5902512	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Terbufos	13071799	2.50E-05		2	Noncancer Risk	0.4	0.4	Noncancer Risk
Terbutryn	886500	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
1,2,4,5-Tetrachlorobenzene	95943	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
1,1,1,2-Tetrachloroethane	630206	3.00E-02	2.60E-02	25	Cancer Risk		25	Cancer Risk
1,1,2,2-Tetrachloroethane	79345		2.00E-01	3.2	Cancer Risk		3.2	Cancer Risk
Tetrachloroethylene (PCE)	127184	1.00E-02	5.20E-02	12	Cancer Risk		12	Cancer Risk
2,3,4,6-Tetrachlorophenol	58902	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
p,a,a,a-Tetrachlorotoluene	5216251		2.00E+01	0.032	Cancer Risk		0.032	Cancer Risk
Tetrachlorovinphos	961115	3.00E-02	2.40E-02	27	Cancer Risk		27	Cancer Risk
Tetraethyldithiopyrophosphate	3689245	5.00E-04		39	Noncancer Risk	7.8	7.8	Noncancer Risk
Tetraethyl lead	78002	1.00E-07		0.0078	Noncancer Risk	0.00156	0.00156	Noncancer Risk
Thallic oxide	1314325	7.00E-05		5.5	Noncancer Risk	1.1	1.1	Noncancer Risk
Thallium acetate	563688	9.00E-05		7	Noncancer Risk	1.4	1.4	Noncancer Risk
Thallium carbonate	6533739	8.00E-05		6.3	Noncancer Risk	1.26	1.26	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Thallium chloride	7791120	8.00E-05		6.3	Noncancer Risk	1.26	1.26	Noncancer Risk
Thallium nitrate	10102451	9.00E-05		7	Noncancer Risk	1.4	1.4	Noncancer Risk
Thallium selenite	12039520	9.00E-05		7	Noncancer Risk	1.4	1.4	Noncancer Risk
Thallium sulfate	7446186	8.00E-05		6.3	Noncancer Risk	1.26	1.26	Noncancer Risk
Thiobencarb	28249776	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
2-(Thiocyanomethylthio)-benzothiazole	21564170	3.00E-02		2300	Noncancer Risk	460	460	Noncancer Risk
Thiofanox	39196184	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Thiophanate-methyl	23564058	8.00E-02		6300	Noncancer Risk	1260	1260	Noncancer Risk
Thiram	137268	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Tin and compounds		6.00E-01		47000	Noncancer Risk	9400	9400	Noncancer Risk
Toluene	108883	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
Toluene-2,4-diamine	95807		3.20E+00	0.2	Cancer Risk		0.2	Cancer Risk
Toluene-2,5-diamine	95705	6.00E-01		47000	Noncancer Risk	9400	9400	Noncancer Risk
Toluene-2,6-diamine	823405	2.00E-01		16000	Noncancer Risk	3200	3200	Noncancer Risk
p-Toluidine	106490		1.90E-01	3.4	Cancer Risk		3.4	Cancer Risk
Toxaphene	8001352		1.10E+00	0.58	Cancer Risk		0.58	Cancer Risk
Tralomethrin	66841256	7.50E-03		590	Noncancer Risk	118	118	Noncancer Risk
Triallate	2303175	1.30E-02		1000	Noncancer Risk	200	200	Noncancer Risk
Triasulfuron	82097505	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
1,2,4-Tribromobenzene	615543	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
Tributyltin oxide (TBTO)	56359	3.00E-05		2.3	Noncancer Risk	0.46	0.46	Noncancer Risk
2,4,6-Trichloroaniline hydrochloride	33663502		2.90E-02	22	Cancer Risk		22	Cancer Risk
2,4,6-Trichloroaniline	634935		3.40E-02	19	Cancer Risk		19	Cancer Risk
1,2,4-Trichlorobenzene	120821	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
1,1,1-Trichloroethane	71556	3.50E-02		2700	Noncancer Risk	540	540	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
1,1,2-Trichloroethane	79005	4.00E-03	5.70E-02	11	Cancer Risk		11	Cancer Risk
Trichloroethylene (TCE)	79016	6.00E-03	1.10E-02	58	Cancer Risk		58	Cancer Risk
Trichlorofluoromethane	75694	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
2,4,5-Trichlorophenol	95954	1.00E-01		7800	Noncancer Risk	1560	1560	Noncancer Risk
2,4,6-Trichlorophenol	88062		1.10E-02	58	Cancer Risk		58	Cancer Risk
2,4,5-Trichlorophenoxyacetic acid	93765	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
2-(2,4,5-Trichlorophenoxy)propionic acid	93721	8.00E-03		630	Noncancer Risk	126	126	Noncancer Risk
1,1,2-Trichloropropane	598776	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
1,2,3-Trichloropropane	96184	6.00E-03	7.00E+00	0.091	Cancer Risk		0.091	Cancer Risk
1,2,3-Trichloropropene	96195	5.00E-03		390	Noncancer Risk	78	78	Noncancer Risk
1,1,2-Trichloro-1,2,2- trifluoroethane	76131	3.00E+01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Tridiphane	58138082	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Trifluralin	1582098	7.50E-03	7.70E-03	83	Cancer Risk		83	Cancer Risk
1,2,4-Trimethylbenzene	95636	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
1,3,5-Trimethylbenzene	108678	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk
Trimethyl phosphate	512561		3.70E-02	17	Cancer Risk		17	Cancer Risk
1,3,5-Trinitrobenzene	99354	5.00E-05		3.9	Noncancer Risk	0.78	0.78	Noncancer Risk
Trinitrophenylmethylnitramine	479458	1.00E-02		780	Noncancer Risk	156	156	Noncancer Risk
2,4,6-Trinitrotoluene	118967	5.00E-04	3.00E-02	21	Cancer Risk		21	Cancer Risk
Uranium (soluble salts)	7440611	3.00E-03		230	Noncancer Risk	46	46	Noncancer Risk
Vanadium	7440622	7.00E-03		550	Noncancer Risk	110	110	Noncancer Risk
Vanadium pentoxide	1314621	9.00E-03		700	Noncancer Risk	140	140	Noncancer Risk
Vanadium sulfate	36907423	2.00E-02		1600	Noncancer Risk	320	320	Noncancer Risk
Vernam	1929777	1.00E-03		78	Noncancer Risk	15.6	15.6	Noncancer Risk
Vinclozolin	50471448	2.50E-02		2000	Noncancer Risk	400	400	Noncancer Risk

APPENDIX 7. METHOD 1 S-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-1 TARGET CONCENTRATIONS	
		(mg/kg-d)	(mg/kg-d)-1	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Vinyl acetate	108054	1.00E+00		78000	Noncancer Risk	15600	15600	Noncancer Risk
Vinyl chloride	75014		1.90E+00	0.34	Cancer Risk		0.34	Cancer Risk
Warfarin	81812	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
m-Xylene	108323	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
o-Xylene	95476	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Xylene (mixed)	1330207	2.00E+00		160000	Noncancer Risk	32000	32000	Noncancer Risk
Zinc	7440666	3.00E-01		23000	Noncancer Risk	4600	4600	Noncancer Risk
Zinc phosphide	1314847	3.00E-04		23	Noncancer Risk	4.6	4.6	Noncancer Risk
Zineb	12122677	5.00E-02		3900	Noncancer Risk	780	780	Noncancer Risk

(*) - Source: U.S. Environmental Protection Agency, Region III - Risk-Based Concentration Table (April 1996)

(**) - Refer to Appendix 12, Defaults and Assumptions, for discussion of target concentration determination for Alkanes and Aromatics, Dioxins and Furans, and Lead

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Acephate	30560191	4.00E-03	8.70E-03	660	Cancer Risk		660	Cancer Risk
Acetochlor	34256821	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Acetone	67641	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Acetone cyanohydrin	75865	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
Acetonitrile	75078	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
Acetophenone	98862	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Acifluorfen	62476599	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Acrolein	107028	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Acrylamide	79061	2.00E-04	4.50E+00	1.3	Cancer Risk		1.3	Cancer Risk
Acrylic acid	79107	5.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Acrylonitrile	107131	1.00E-03	5.40E-01	11	Cancer Risk		11	Cancer Risk
Alachlor	15972608	1.00E-02	8.00E-02	72	Cancer Risk		72	Cancer Risk
Alar	1596845	1.50E-01		310000	Noncancer Risk	62000	62000	Noncancer Risk
Aldicarb	116063	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Aldicarb sulfone	1646884	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Aldrin	309002	3.00E-05	1.70E+01	0.34	Cancer Risk		0.34	Cancer Risk
Alkanes (**)								
C_5-C_8		6.00E-02		122640	Noncancer Risk	24528	24528	Noncancer Risk
C_9-C_{18}		6.00E-01		1226400	Noncancer Risk	245280	245280	Noncancer Risk
C_{19}-C_{32}		6.00E+00		12264000	Noncancer Risk	2452800	2452800	Noncancer Risk
Ally	74223646	2.50E-01		510000	Noncancer Risk	102000	102000	Noncancer Risk
Allyl alcohol	107186	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Allyl chloride	107051	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Aluminum	7429905	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Aluminum phosphide	20859738	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Amdro	67485294	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Ametryn	834128	9.00E-03		18000	Noncancer Risk	3600	3600	Noncancer Risk
m-Aminophenol	591275	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
4-Aminopyridine	504245	2.00E-05		41	Noncancer Risk	8.2	8.2	Noncancer Risk
Amitraz	33089611	2.50E-03		5100	Noncancer Risk	1020	1020	Noncancer Risk
Ammonium sulfamate	7773060	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Aniline	62533		5.70E-03	1000	Cancer Risk		1000	Cancer Risk
Antimony and compounds	7440360	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Antimony pentoxide	1314609	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
Antimony potassium tartrate	304610	9.00E-04		1800	Noncancer Risk	360	360	Noncancer Risk
Antimony tetroxide	1332316	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Antimony trioxide	1309644	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Apollo	74115245	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Aramite	140578	5.00E-02	2.50E-02	230	Cancer Risk		230	Cancer Risk
Aromatics C_9-C_{32} (**)		3.00E-02		61320	Noncancer Risk	12264	12264	Noncancer Risk
Arsenic	7440382	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Arsenic (as carcinogen)	7440382		1.50E+00	3.8	Cancer Risk		3.8	Cancer Risk
Assure	76578148	9.00E-03		18000	Noncancer Risk	3600	3600	Noncancer Risk
Asulam	3337711	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Atrazine	1912249	3.50E-02	2.22E-01	26	Cancer Risk		26	Cancer Risk
Avermectin B1	65195553	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Azobenzene	103333		1.10E-01	52	Cancer Risk		52	Cancer Risk
Barium and compounds	7440393	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
Baygon	114261	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
Bayleton	43121433	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg-d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Baythroid	68359375	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Benefin	1861401	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Benomyl	17804352	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Bentazon	25057890	2.50E-03		5100	Noncancer Risk	1020	1020	Noncancer Risk
Benzaldehyde	100527	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Benzene	71432		2.90E-02	200	Cancer Risk		200	Cancer Risk
Benzenethiol	108985	1.00E-05		20	Noncancer Risk	4	4	Noncancer Risk
Benzidine	92875	3.00E-03	2.30E+02	0.025	Cancer Risk		0.025	Cancer Risk
Benzoic acid	65850	4.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Benzotrichloride	98077		1.30E+01	0.44	Cancer Risk		0.44	Cancer Risk
Benzyl alcohol	100516	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Benzyl chloride	100447		1.70E-01	34	Cancer Risk		34	Cancer Risk
Beryllium and compounds	7440417	5.00E-03	4.30E+00	1.3	Cancer Risk		1.3	Cancer Risk
Bidrin	141662	1.00E-04		200	Noncancer Risk	40	40	Noncancer Risk
Biphenthrin (Talstar)	82657043	1.50E-02		31000	Noncancer Risk	6200	6200	Noncancer Risk
1,1-Biphenyl	92524	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Bis(2-chloroethyl)ether	111444		1.10E+00	5.2	Cancer Risk		5.2	Cancer Risk
Bis(2-chloroisopropyl)ether	39638329	4.00E-02	7.00E-02	82	Cancer Risk		82	Cancer Risk
Bis(chloromethyl)ether	542881		2.20E+02	0.026	Cancer Risk		0.026	Cancer Risk
Bis(2-chloro-1-methylethyl)ether			7.00E-02	82	Cancer Risk		82	Cancer Risk
Bis(2-ethylhexyl)phthalate (DEHP)	117817	2.00E-02	1.40E-02	410	Cancer Risk		410	Cancer Risk
Bisphenol A	80057	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Boron (and borates)	7440428	9.00E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk
Bromodichloromethane	75274	2.00E-02	6.20E-02	92	Cancer Risk		92	Cancer Risk
Bromoform (tribromomethane)	75252	2.00E-02	7.90E-03	720	Cancer Risk		720	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Bromomethane	74839	1.40E-03		2900	Noncancer Risk	580	580	Noncancer Risk
4-Bromophenyl phenyl ether	101553	5.80E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Bromophos	2104963	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Bromoxynil	1689845	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Bromoxynil octanoate	1689992	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
1-Butanol	71363	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Butyl benzyl phthalate	85687	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Butylate	2008415	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
sec-Butylbenzene	135988	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
tert-Butylbenzene	104518	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Butylphthalyl butylglycolate	85701	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Cacodylic acid	75605	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Cadmium and compounds	7440439	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
Caprolactam	105602	5.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Captafol	2425061	2.00E-03	8.60E-03	670	Cancer Risk		670	Cancer Risk
Captan	133062	1.30E-01	3.50E-03	1600	Cancer Risk		1600	Cancer Risk
Carbaryl	63252	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Carbofuran	1563662	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Carbon disulfide	75150	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Carbon tetrachloride	56235	7.00E-04	1.30E-01	44	Cancer Risk		44	Cancer Risk
Carbosulfan	55285148	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Carboxin	5234684	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Chloral	75876	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Chloramben	133904	1.50E-02		31000	Noncancer Risk	6200	6200	Noncancer Risk
Chloranil	118752		4.03E-01	14	Cancer Risk		14	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Chlordane	57749	6.00E-05	1.30E+00	4.4	Cancer Risk		4.4	Cancer Risk
Chlorimuron-ethyl	90982324	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Chlorine	7782505	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Chlorine Cyanide	506774	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Chloroacetaldehyde	107200	6.90E-03		14000	Noncancer Risk	2800	2800	Noncancer Risk
Chloroacetic acid	79118	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
4-Chloroaniline	106478	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
Chlorobenzene	108907	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Chlorobenzilate	510156	2.00E-02	2.70E-01	21	Cancer Risk		21	Cancer Risk
p-Chlorobenzoic acid	74113	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
4-Chlorobenzotrifluoride	98566	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
2-Chloro-1,3-butadiene	126998	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
1-Chlorobutane	109693	4.00E-01		820000	Noncancer Risk	164000	164000	Noncancer Risk
Chlorodibromomethane	124481	2.00E-02	8.40E-02	68	Cancer Risk		68	Cancer Risk
Chloroethane	75003	4.00E-01		820000	Noncancer Risk	164000	164000	Noncancer Risk
2-Chloroethyl vinyl ether	110758	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Chloroform	67663	1.00E-02	6.10E-03	940	Cancer Risk		940	Cancer Risk
Chloromethane	74873		1.30E-02	440	Cancer Risk		440	Cancer Risk
4-Chloro-2,2-methylaniline hydrochloride	3165933		4.60E-01	12	Cancer Risk		12	Cancer Risk
4-Chloro-2-methylaniline	95692		5.80E-01	9.9	Cancer Risk		9.9	Cancer Risk
beta-Chloronaphthalene	91587	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
o-Chloronitrobenzene	88733		2.50E-02	230	Cancer Risk		230	Cancer Risk
p-Chloronitrobenzene	100005		1.80E-02	320	Cancer Risk		320	Cancer Risk
2-Chlorophenol	95578	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Chlorothalonil	1897456	1.50E-02	1.10E-02	520	Cancer Risk		520	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
o-Chlorotoluene	95498	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Chlorpropham	101213	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Chlorpyrifos	2921882	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Chlorpyrifos-methyl	5598130	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Chlorsulfuron	64902723	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Chlorthiophos	60238564	8.00E-04		1600	Noncancer Risk	320	320	Noncancer Risk
Chromium III and compounds	16065831	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Chromium VI and compounds	18540299	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Cobalt	7440484	6.00E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Copper and compounds	7440508	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Crotonaldehyde	123739	1.00E-02	1.90E+00	3	Cancer Risk		3	Cancer Risk
Cumene	98828	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Cyanides:					Noncancer Risk			
Barium cyanide	542621	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Calcium cyanide	592018	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Copper cyanide	544923	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Cyanazine	21725462	2.00E-03	8.40E-01	6.8	Cancer Risk		6.8	Cancer Risk
Cyanogen	460195	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Cyanogen bromide	506683	9.00E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk
Cyanogen chloride	506774	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Free cyanide	57125	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Hydrogen cyanide	74908	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Potassium cyanide	151508	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Potassium silver cyanide	506616	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Silver cyanide	506649	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Sodium cyanide	143339	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Thiocyanate		2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Zinc cyanide	557211	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Cyclohexanone	108941	5.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Cyclohexlamine	108918	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Cyhalothrin/Karate	68085858	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Cypermethrin	52315078	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Cyromazine	66215278	7.50E-03		15000	Noncancer Risk	3000	3000	Noncancer Risk
Dacthal	1861321	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Dalapon	75990	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Danitol	39515418	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
DDD	72548		2.40E-01	24	Cancer Risk		24	Cancer Risk
DDE	72559		3.40E-01	17	Cancer Risk		17	Cancer Risk
DDT	50293	5.00E-04	3.40E-01	17	Cancer Risk		17	Cancer Risk
Decabromodiphenyl ether	1163195	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Demeton	8065483	4.00E-05		82	Noncancer Risk	16.4	16.4	Noncancer Risk
Diallate	2303164		6.10E-02	94	Cancer Risk		94	Cancer Risk
Diazinon	333415	9.00E-04		1800	Noncancer Risk	360	360	Noncancer Risk
Dibenzofuran	132649	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
1,4-Dibromobenzene	106376	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
1,2-Dibromo-3-chloropropane	96128		1.40E+00	4.1	Cancer Risk		4.1	Cancer Risk
1,2-Dibromoethane	106934		8.50E+01	0.067	Cancer Risk		0.067	Cancer Risk
Dibutyl phthalate	84742	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Dicamba	1918009	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
1,2-Dichlorobenzene	95501	9.00E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	(mg/kg-d)$^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
1,3-Dichlorobenzene	541731	8.90E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk
1,4-Dichlorobenzene	106467		2.40E-02	240	Cancer Risk		240	Cancer Risk
3,3'-Dichlorobenzidine	91941		4.50E-01	13	Cancer Risk		13	Cancer Risk
Dichlorodifluoromethane	75718	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
1,1-Dichloroethane	75343	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
1,2-Dichloroethane (EDC)	107062		9.10E-02	63	Cancer Risk		63	Cancer Risk
1,1-Dichloroethylene	75354	9.00E-03	6.00E-01	9.5	Cancer Risk		9.5	Cancer Risk
1,2-Dichloroethylene (cis)	156592	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
1,2-Dichloroethylene (trans)	156605	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
1,2-Dichloroethylene (mixture)	540590	9.00E-03		18000	Noncancer Risk	3600	3600	Noncancer Risk
2,4-Dichlorophenol	120832	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
2,4-Dichlorophenoxyacetic Acid (2, 4-D)	94757	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
4-(2,4-Dichlorophenoxy)butyric Acid	94826	8.00E-03		16000	Noncancer Risk	3200	3200	Noncancer Risk
1,2-Dichloropropane	78875		6.80E-02	84	Cancer Risk		84	Cancer Risk
2,3-Dichloropropanol	616239	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
1,3-Dichloropropene	542756	3.00E-04	1.75E-01	33	Cancer Risk		33	Cancer Risk
Dichlorvos	62737	5.00E-04	2.90E-01	20	Cancer Risk		20	Cancer Risk
Dicofol	115322		4.40E-01	13	Cancer Risk		13	Cancer Risk
Dicyclopentadiene	77736	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Dieldrin	60571	5.00E-05	1.60E+01	0.36	Cancer Risk		0.36	Cancer Risk
Diethyl phthalate	84662	8.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Diethylene glycol, monoethyl ether	111900	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Diethylforamide	617845	1.10E-02		22000	Noncancer Risk	4400	4400	Noncancer Risk
Di(2-ethylhexyl)adipate	103231	6.00E-01	1.20E-03	4800	Cancer Risk		4800	Cancer Risk
Diethylstilbestrol	56531		4.70E+03	0.0012	Cancer Risk		0.0012	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Difenzoquat (Avenge)	43222486	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
Diflubenzuron	35367385	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Diisopropyl methylphosphonate (DIMP)	1445756	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
Dimethipin	55290647	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Dimethoate	60515	2.00E-04		410	Noncancer Risk	82	82	Noncancer Risk
3,3'-Dimethoxybenzidine	119904		1.40E-02	410	Cancer Risk		410	Cancer Risk
2,4-Dimethylaniline hydrochloride	21436964		5.80E-01	9.9	Cancer Risk		9.9	Cancer Risk
2,4-Dimethylaniline	95681		7.50E-01	7.6	Cancer Risk		7.6	Cancer Risk
N-N-Dimethylaniline	121697	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
3,3'-Dimethylbenzidine	119937		9.20E+00	0.62	Cancer Risk		0.62	Cancer Risk
N,N-Dimethylformamide	68122	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
1,1-Dimethylhydrazine	57147		2.60E+00	2.2	Cancer Risk		2.2	Cancer Risk
1,2-Dimethylhydrazine	540738		3.70E+01	0.15	Cancer Risk		0.15	Cancer Risk
2,4-Dimethylphenol	105679	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
2,6-Dimethylphenol	576261	6.00E-04		1200	Noncancer Risk	240	240	Noncancer Risk
3,4-Dimethylphenol	95658	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Dimethyl phthalate	131113	1.00E+01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Dimethyl terephthalate	120616	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
1,2-Dinitrobenzene	528290	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
1,3-Dinitrobenzene	99650	1.00E-04		200	Noncancer Risk	40	40	Noncancer Risk
1,4-Dinitrobenzene	100254	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
4,6-Dinitro-o-cyclohexyl phenol	131895	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
2,4-Dinitrophenol	51285	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Dinitrotoluene mixture			6.80E-01	8.4	Cancer Risk		8.4	Cancer Risk
2,4-Dinitrotoluene	121142	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg-d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
2,6-Dinitrotoluene	606202	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Dinoseb	88857	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
di-n-Octyl phthalate	117840	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
1,4-Dioxane	123911		1.10E-02	520	Cancer Risk		520	Cancer Risk
Dioxins and Furans (**)								
2,3,7,8-HpCDD				0.0037	Cancer Risk		0.0037	Cancer Risk
2,3,7,8-HpCDF				0.0037	Cancer Risk		0.0037	Cancer Risk
2,3,7,8-HxCDD				0.00037	Cancer Risk		0.00037	Cancer Risk
2,3,7,8-HxCDF				0.00037	Cancer Risk		0.00037	Cancer Risk
OCDD	3268879			0.037	Cancer Risk		0.037	Cancer Risk
OCDF				0.037	Cancer Risk		0.037	Cancer Risk
2,3,7,8-PeCDD				0.000074	Cancer Risk		0.000074	Cancer Risk
1,2,3,7,8-PeCDF	57117416			0.00074	Cancer Risk		0.00074	Cancer Risk
2,3,4,7,8-PeCDF	57117314			0.000074	Cancer Risk		0.000074	Cancer Risk
2,3,7,8-TCDD (dioxin)	1746016		1.56E+05	0.000037	Cancer Risk		0.000037	Cancer Risk
2,3,7,8-TCDF	51207319			0.00037	Cancer Risk		0.00037	Cancer Risk
Diphenamid	957517	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Diphenylamine	122394	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
1,2-Diphenylhydrazine	122667		8.00E-01	7.2	Cancer Risk		7.2	Cancer Risk
Diquat	85007	2.20E-03		4500	Noncancer Risk	900	900	Noncancer Risk
Direct black 38	1937377		8.60E+00	0.67	Cancer Risk		0.67	Cancer Risk
Direct blue 6	2602462		8.10E+00	0.71	Cancer Risk		0.71	Cancer Risk
Direct brown 95	16071866		9.30E+00	0.62	Cancer Risk		0.62	Cancer Risk
Disulfoton	298044	4.00E-05		82	Noncancer Risk	16.4	16.4	Noncancer Risk
1,4-Dithiane	505293	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Diuron	330541	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Dodine	2439103	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
Eicosane (**)		6.00E+00		12264000	Noncancer Risk	2452800	2452800	Noncancer Risk
Endosulfan	115297	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
Endothall	145733	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Endrin	72208	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Epichlorohydrin	106898	2.00E-03	9.90E-03	580	Cancer Risk		580	Cancer Risk
Ethephon (2-chloroethyl phosphonic acid)	16672870	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Ethion	563122	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
2-Ethoxyethanol acetate	111159	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
2-Ethoxyethanol	110805	4.00E-01		820000	Noncancer Risk	164000	164000	Noncancer Risk
Ethyl acrylate	140885		4.80E-02	120	Cancer Risk		120	Cancer Risk
EPTC (S-Ethyl dipropylthiocarbamate)	759944	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Ethyl acetate	141786	9.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Ethylbenzene	100414	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Ethylene cyanohydrin	109784	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Ethylene diamine	107153	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Ethylene glycol	107211	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Ethylene oxide	75218		1.02E+00	5.6	Cancer Risk		5.6	Cancer Risk
Ethylene thiourea (ETU)	96457	8.00E-05	1.19E-01	48	Cancer Risk		48	Cancer Risk
Ethyl ether	60297	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Ethyl methacrylate	97632	9.00E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk
Ethyl p-nitrophenyl phenylphosphorothioate	2104645	1.00E-05		20	Noncancer Risk	4	4	Noncancer Risk
Ethylnitrosourea	759739		1.40E+02	0.041	Cancer Risk		0.041	Cancer Risk
Ethylphthalyl ethyl glycolate	84720	3.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Express	10120	8.00E-03		16000	Noncancer Risk	3200	3200	Noncancer Risk
Fenamiphos	22224926	2.50E-04		510	Noncancer Risk	102	102	Noncancer Risk
Fluometuron	2164172	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Fluoride	7782414	6.00E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Fluoridone	59756604	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
Flurprimidol	56425913	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Flutolanil	66332965	6.00E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Fluvalinate	69409945	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Folpet	133073	1.00E-01	3.50E-03	1600	Cancer Risk		1600	Cancer Risk
Fomesafen	72178020		1.90E-01	30	Cancer Risk		30	Cancer Risk
Fonofos	944229	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Formaldehyde	50000	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Formic Acid	64186	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Fosetyl-al	39148248	3.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Furan	110009	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Furazolidone	67458		3.80E+00	1.5	Cancer Risk		1.5	Cancer Risk
Furfural	98011	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Furium	531828		5.00E+01	0.11	Cancer Risk		0.11	Cancer Risk
Furmecyclox	60568050		3.00E-02	190	Cancer Risk		190	Cancer Risk
Glufosinate-ammonium	77182822	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Glycidaldehyde	765344	4.00E-04		820	Noncancer Risk	164	164	Noncancer Risk
Glyphosate	1071836	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Haloxyfop-methyl	69806402	5.00E-05		100	Noncancer Risk	20	20	Noncancer Risk
Harmony	79277273	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
HCH (alpha)	319846		6.30E+00	0.91	Cancer Risk		0.91	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
HCH (beta)	319857		1.80E+00	3.2	Cancer Risk		3.2	Cancer Risk
HCH (gamma) Lindane	58899	3.00E-04	1.30E+00	4.4	Cancer Risk		4.4	Cancer Risk
HCH-technical	608731		1.80E+00	3.2	Cancer Risk		3.2	Cancer Risk
Heptachlor	76448	5.00E-04	4.50E+00	1.3	Cancer Risk		1.3	Cancer Risk
Heptachlor epoxide	1024573	1.30E-05	9.10E+00	0.63	Cancer Risk		0.63	Cancer Risk
Hexabromobenzene	87821	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Hexachlorobenzene	118741	8.00E-04	1.60E+00	3.6	Cancer Risk		3.6	Cancer Risk
Hexachlorobutadiene	87683	2.00E-04	7.80E-02	73	Cancer Risk		73	Cancer Risk
Hexachlorocyclopentadiene	77474	7.00E-03		14000	Noncancer Risk	2800	2800	Noncancer Risk
Hexachlorodibenzo-p-dioxin mixture	19408743		6.20E+03	0.00092	Cancer Risk		0.00092	Cancer Risk
Hexachloroethane	67721	1.00E-03	1.40E-02	410	Cancer Risk		410	Cancer Risk
Hexachlorophene	70304	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121824	3.00E-03	1.10E-01	52	Cancer Risk		52	Cancer Risk
n-Hexane (**)	110543	6.00E-02		122640	Noncancer Risk	24528	24528	Noncancer Risk
Hexazinone	51235042	3.30E-02		67000	Noncancer Risk	13400	13400	Noncancer Risk
Hydrazine, hydrazine sulfate	302012		3.00E+00	1.9	Cancer Risk		1.9	Cancer Risk
Hydrogen sulfide	7783064	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Hydroquinone	123319	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Imazalil	35554440	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Imazaquin	81335377	2.50E-01		510000	Noncancer Risk	102000	102000	Noncancer Risk
Iprodione	36734197	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Iron	7439896	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Isobutanol	78831	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Isophorone	78591	2.00E-01	9.50E-04	6000	Cancer Risk		6000	Cancer Risk
Isopropalin	33820530	1.50E-02		31000	Noncancer Risk	6200	6200	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Isopropyl methyl phosphonic acid	1832548	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Isoxaben	82558507	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Kepone	143500		1.80E+01	0.32	Cancer Risk		0.32	Cancer Risk
Lactofen	77501634	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Lead (**)	7439921			400	Noncancer Risk	400	400	Noncancer Risk
Linuron	330552	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Lithium	7439932	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Londax	83056996	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Malathion	121755	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Maleic anhydride	108316	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Maleic hydrazide	123331	5.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Malononitrile	109773	2.00E-05		41	Noncancer Risk	8.2	8.2	Noncancer Risk
Mancozeb	8018017	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Maneb	12427382	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Manganese and compounds	7439965	2.30E-02		48000	Noncancer Risk	9600	9600	Noncancer Risk
Mephosfolan	950107	9.00E-05		180	Noncancer Risk	36	36	Noncancer Risk
Mepiquat chloride	24307264	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Mercuric chloride	7487947	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Mercury (inorganic)	7439976	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Mercury (methyl)	22967926	1.00E-04		200	Noncancer Risk	40	40	Noncancer Risk
Merphos	150505	3.00E-05		61	Noncancer Risk	12.2	12.2	Noncancer Risk
Merphos oxide	78488	3.00E-05		61	Noncancer Risk	12.2	12.2	Noncancer Risk
Metalaxyl	57837191	6.00E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Methacrylonitrile	126987	1.00E-04		200	Noncancer Risk	40	40	Noncancer Risk
Methamidophos	10265926	5.00E-05		100	Noncancer Risk	20	20	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Methanol	67561	5.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Methidathion	950378	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Methomyl	16752775	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Methoxychlor	72435	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
2-Methoxyethanol acetate	110496	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
2-Methoxyethanol	109864	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
2-Methoxy-5-nitroaniline	99592		4.60E-02	120	Cancer Risk		120	Cancer Risk
Methyl acetate	79209	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Methyl acrylate	96333	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
2-Methylaniline hydrochloride	636215		1.80E-01	32	Cancer Risk		32	Cancer Risk
2-Methylaniline	95534		2.40E-01	24	Cancer Risk		24	Cancer Risk
Methyl chlorocarbonate	79221	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
4-(2-Methyl-4-chlorophenoxy) butyric acid	94815	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
2-Methyl-4-chlorophenoxyacetic acid	94746	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
2-(2-Methyl-14-chlorophenoxy)propionic acid	93652	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Methylene bromide	74953	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Methylene chloride	75092	6.00E-02	7.50E-03	760	Cancer Risk		760	Cancer Risk
4,4'-Methylene bis(2-chloroaniline)	101144	7.00E-04	1.30E-01	44	Cancer Risk		44	Cancer Risk
4,4'-Methylenebisbenzeneamine	101779		2.50E-01	23	Cancer Risk		23	Cancer Risk
4,4'-Methylene bis(N,N'-dimethyl)aniline	101611		4.60E-02	120	Cancer Risk		120	Cancer Risk
Methyl ethyl ketone	78933	6.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Methyl hydrazine	60344		1.10E+00	5.2	Cancer Risk		5.2	Cancer Risk
Methyl isobutyl ketone	108101	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
Methyl methacrylate	80626	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
2-Methyl-5-nitroaniline	99558		3.30E-02	170	Cancer Risk		170	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Methyl parathion	298000	2.50E-04		510	Noncancer Risk	102	102	Noncancer Risk
2-Methylphenol (o-cresol)	95487	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
3-Methylphenol (m-cresol)	103394	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
4-Methylphenol (p-cresol)	106445	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Methyl styrene (mixture)	25013154	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
Methyl styrene (alpha)	98839	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
Methyl tertbutyl ether (MTBE)	1634044	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Metolaclor (Dual)	51218452	1.50E-01		310000	Noncancer Risk	62000	62000	Noncancer Risk
Metribuzin	21087649	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Mirex	2385855	2.00E-04	1.80E+00	3.2	Cancer Risk		3.2	Cancer Risk
Molinate	2212671	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Molybdenum	7439987	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Monochloramine	10599903	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Naled	300765	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
2-Naphthylamine	91598		1.30E+02	0.044	Cancer Risk		0.044	Cancer Risk
Napropamide	15299997	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Nickel and compounds	7440020	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Nitrapyrin	1929824	1.50E-03		3100	Noncancer Risk	620	620	Noncancer Risk
Nitrate	14797558	1.60E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Nitric Oxide	10102439	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
Nitrite	14797650	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
2-Nitroaniline	88744	6.00E-05		120	Noncancer Risk	24	24	Noncancer Risk
3-Nitroaniline	99092	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
4-Nitroaniline	100016	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Nitrobenzene	98953	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Nitrofurantoin	67209	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
Nitrofurazone	59870		1.50E+00	3.8	Cancer Risk		3.8	Cancer Risk
Nitrogen dioxide	10102440	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Nitroguanidine	556887	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
4-Nitrophenol	100027	6.20E-02		130000	Noncancer Risk	26000	26000	Noncancer Risk
N-Nitrosodi-n-butylamine	924163		5.40E+00	1.1	Cancer Risk		1.1	Cancer Risk
N-Nitrosodiethanolamine	1116547		2.80E+00	2	Cancer Risk		2	Cancer Risk
N-Nitrosodiethylamine	55185		1.50E+02	0.038	Cancer Risk		0.038	Cancer Risk
N-Nitrosodimethylamine	62759		5.10E+01	0.11	Cancer Risk		0.11	Cancer Risk
N-Nitrosodiphenylamine	86306		4.90E-03	1200	Cancer Risk		1200	Cancer Risk
N-Nitroso di-n-propylamine	621647		7.00E+00	0.82	Cancer Risk		0.82	Cancer Risk
N-Nitroso-N-methylethylamine	10595956		2.20E+01	0.26	Cancer Risk		0.26	Cancer Risk
N-Nitrosopyrrolidine	930552		2.10E+00	2.7	Cancer Risk		2.7	Cancer Risk
m-Nitrotoluene	99081	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
o-Nitrotoluene	88722	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
p-Nitrotoluene	99990	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
n-Nonane (**)	111842	6.00E-01		1226400	Noncancer Risk	245280	245280	Noncancer Risk
Norflurazon	27314132	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
NuStar	85509199	7.00E-04		1400	Noncancer Risk	280	280	Noncancer Risk
Octabromodiphenyl ether	32536520	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Octahydro-1357-tetranitro-1357-tetrazocine	2691410	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Octamethylpyrophosphoramide	152169	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Oryzalin	19044883	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Oxadiazon	19666309	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Oxamyl	23135220	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Oxyfluorfen	42874033	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Paclobutrazol	76738620	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancar Risk
Paraquat	1910425	4.50E-03		9200	Noncancer Risk	1840	1840	Noncancar Risk
Parathion	56382	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
Pebulate	1114712	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancar Risk
Pendimethalin	40487421	4.00E-02		82000	Noncancar Risk	16400	16400	Noncancer Risk
Pentabromo-6-chloro cyclohexane	87843		2.30E-02	250	Cancar Risk		250	Cancer Risk
Pentabromodiphenyl ether	32534819	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Pentachlorobenzene	608935	8.00E-04		1600	Noncancer Risk	320	320	Noncancer Risk
Pentachloronitrobenzene	82688	3.00E-03	2.60E-01	22	Cancer Risk		22	Cancer Risk
Pentachlorophenol	87865	3.00E-02	1.20E-01	48	Cancer Risk		48	Cancer Risk
Permethrin	52645531	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Phenmedipham	13684634	2.50E-01		510000	Noncancer Risk	102000	102000	Noncancer Risk
Phenol	108952	6.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
m-Phenylenediamine	108452	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
p-Phenylenediamine	106503	1.90E-01		390000	Noncancer Risk	78000	78000	Noncancer Risk
Phenylmercuric acetate	62384	8.00E-05		160	Noncancer Risk	32	32	Noncancer Risk
2-Phenylphenol	90437		1.94E-03	3000	Cancer Risk		3000	Cancer Risk
Phorate	298022	2.00E-04		410	Noncancer Risk	82	82	Noncancer Risk
Phosmet	732116	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Phosphine	7803512	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Phosphorus (white)	7723140	2.00E-05		41	Noncancer Risk	8.2	8.2	Noncancer Risk
p-Phthalic acid	100210	1.00E+00		1000000	Noncancar Risk	200000	200000	Noncancer Risk
Phthalic anhydride	85449	2.00E+00		1000000	Noncancar Risk	200000	200000	Noncancer Risk
Picloram	1918021	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Pirimiphos-methyl	29232937	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
Polybrominated biphenyls		7.00E-06	8.90E+00	0.64	Cancer Risk		0.64	Cancer Risk
Polychlorinated biphenyls (PCBs)	1336363		7.70E+00	0.74	Cancer Risk		0.74	Cancer Risk
Aroclor 1016	12674112	7.00E-05		140	Noncancer Risk	28	28	Noncancer Risk
Aroclor 1254	11097691	2.00E-05		41	Noncancer Risk	8.2	8.2	Noncancer Risk
Polychlorinated terphenyls (PCTs)			4.50E+00	1.3	Cancer Risk		1.3	Cancer Risk
Polynuclear aromatic hydrocarbons					Noncancer Risk			
Acenaphthene	83329	6.00E-02		120000	Noncancer Risk	24000	24000	Noncancer Risk
Anthracene	120127	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Benz[a]anthracene	56553		7.30E-01	7.8	Cancer Risk		7.8	Cancer Risk
Benzo[b]fluoranthene	205992		7.30E-01	7.8	Cancer Risk		7.8	Cancer Risk
Benzo[k]fluoranthene	207089		7.30E-02	78	Cancer Risk		78	Cancer Risk
Benzo[a]pyrene	50328		7.30E+00	0.78	Cancer Risk		0.78	Cancer Risk
Carbazole	86748		2.00E-02	290	Cancer Risk		290	Cancer Risk
Chrysene	218019		7.30E-03	780	Cancer Risk		780	Cancer Risk
Dibenz[ah]anthracene	53703		7.30E+00	0.78	Cancer Risk		0.78	Cancer Risk
Fluoranthene	206440	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Fluorene	86737	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Indeno[1,2,3-cd]pyrene	193395		7.30E-01	7.8	Cancer Risk		7.8	Cancer Risk
Naphthalene	91203	4.00E-02		82000	Noncancer Risk	16400	16400	Noncancer Risk
Pyrene (**)	129000	3.00E-02		61320	Noncancer Risk	12264	12264	Noncancer Risk
Prochloraz	67747095	9.00E-03	1.50E-01	38	Cancer Risk		38	Cancer Risk
Profluralin	26399360	6.00E-03		12000	Noncancer Risk	2400	2400	Noncancer Risk
Prometon	1610180	1.50E-02		31000	Noncancer Risk	6200	6200	Noncancer Risk
Prometryn	7287196	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Pronamide	23950585	7.50E-02		150000	Noncancer Risk	30000	30000	Noncancer Risk
Propachlor	1918167	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Propanil	709988	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Propargite	2312358	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Propargyl alcohol	107197	2.00E-03		4100	Noncancer Risk	820	820	Noncancer Risk
Propazine	139402	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Propham	122429	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Propiconazole	60207901	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Propylene glycol	57556	2.00E+01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Propylene glycol, monoethyl ether	52125538	7.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Propylene glycol, monomethyl ether	107982	7.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Propylene oxide	75569		2.40E-01	24	Cancer Risk		24	Cancer Risk
Pursuit	81335775	2.50E-01		510000	Noncancer Risk	102000	102000	Noncancer Risk
Pydrin	51630581	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Pyridine	110861	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Quinalphos	13593038	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
Quinoline	91225		1.20E+01	0.48	Cancer Risk		0.48	Cancer Risk
Resmethrin	10463868	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Ronnel	299843	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Rotenone	83794	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
Savey	78587050	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Selenious Acid	7783008	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Selenium	7782492	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Selenourea	630104	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Sethoxydim	74051802	9.00E-02		180000	Noncancer Risk	36000	36000	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	(mg/kg-d)$^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Silver and compounds	7440224	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Simazine	122349	5.00E-03	1.20E-01	48	Cancer Risk		48	Cancer Risk
Sodium azide	26628228	4.00E-03		8200	Noncancer Risk	1640	1640	Noncancer Risk
Sodium diethyldithiocarbamate	148185	3.00E-02	2.70E-01	21	Cancer Risk		21	Cancer Risk
Sodium fluoroacetate	62748	2.00E-05		41	Noncancer Risk	8.2	8.2	Noncancer Risk
Sodium metavanadate	13718268	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Strontium, stable	7440246	6.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Strychnine	57249	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Styrene	100425	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
Systhane	88671890	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Tebuthiuron	34014181	7.00E-02		140000	Noncancer Risk	28000	28000	Noncancer Risk
Temephos	3383968	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk
Terbacil	5902512	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Terbufos	13071799	2.50E-05		51	Noncancer Risk	10.2	10.2	Noncancer Risk
Terbutryn	886500	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
1,2,4,5-Tetrachlorobenzene	95943	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
1,1,1,2-Tetrachloroethane	630206	3.00E-02	2.60E-02	220	Cancer Risk		220	Cancer Risk
1,1,2,2-Tetrachloroethane	79345		2.00E-01	29	Cancer Risk		29	Cancer Risk
Tetrachloroethylene (PCE)	127184	1.00E-02	5.20E-02	110	Cancer Risk		110	Cancer Risk
2,3,4,6-Tetrachlorophenol	58902	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
p,a,a,a-Tetrachlorotoluene	5216251		2.00E+01	0.29	Cancer Risk		0.29	Cancer Risk
Tetrachlorovinphos	961115	3.00E-02	2.40E-02	240	Cancer Risk		240	Cancer Risk
Tetraethyldithiopyrophosphate	3689245	5.00E-04		1000	Noncancer Risk	200	200	Noncancer Risk
Tetraethyl lead	78002	1.00E-07		0.2	Noncancer Risk	0.04	0.04	Noncancer Risk
Thallic oxide	1314325	7.00E-05		140	Noncancer Risk	28	28	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	(mg/kg-d)$^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Thallium acetate	563688	9.00E-05		180	Noncancer Risk	36	36	Noncancer Risk
Thallium carbonate	6533739	8.00E-05		160	Noncancer Risk	32	32	Noncancer Risk
Thallium chloride	7791120	8.00E-05		160	Noncancer Risk	32	32	Noncancer Risk
Thallium nitrate	10102451	9.00E-05		180	Noncancer Risk	36	36	Noncancer Risk
Thallium selenite	12039520	9.00E-05		180	Noncancer Risk	36	36	Noncancer Risk
Thallium sulfate	7446186	8.00E-05		160	Noncancer Risk	32	32	Noncancer Risk
Thiobencarb	28249776	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
2-(Thiocyanomethylthio)-benzothiazole	21564170	3.00E-02		61000	Noncancer Risk	12200	12200	Noncancer Risk
Thiofanox	39196184	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Thiophanate-methyl	23564058	8.00E-02		160000	Noncancer Risk	32000	32000	Noncancer Risk
Thiram	137268	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Tin and compounds		6.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Toluene	108883	2.00E-01		410000	Noncancer Risk	82000	82000	Noncencer Risk
Toluene-2,4-diamine	95807		3.20E+00	1.8	Cancer Risk		1.8	Cancer Risk
Toluene-2,5-diamine	95705	6.00E-01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Toluene-2,6-diamine	823405	2.00E-01		410000	Noncancer Risk	82000	82000	Noncancer Risk
p-Toluidine	106490		1.90E-01	30	Cancer Risk		30	Cancer Risk
Toxaphene	8001352		1.10E+00	5.2	Cancer Risk		5.2	Cancer Risk
Tralomethrin	66841256	7.50E-03		15000	Noncancer Risk	3000	3000	Noncancer Risk
Triallate	2303175	1.30E-02		27000	Noncancer Risk	5400	5400	Noncancer Risk
Triasulfuron	82097505	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
1,2,4-Tribromobenzene	615543	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
Tributyltin oxide (TBTO)	56359	3.00E-05		61	Noncancer Risk	12.2	12.2	Noncancer Risk
2,4,6-Trichloroaniline hydrochloride	33663502		2.90E-02	200	Cancer Risk		200	Cancer Risk
2,4,6-Trichloroaniline	634935		3.40E-02	170	Cancer Risk		170	Cancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	(mg/kg-d)$^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
1,2,4-Trichlorobenzene	120821	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
1,1,1-Trichloroethane	71556	3.50E-02		72000	Noncancer Risk	14400	14400	Noncancer Risk
1,1,2-Trichloroethane	79005	4.00E-03	5.70E-02	100	Cancer Risk		100	Cancer Risk
Trichloroethylene (TCE)	79016	6.00E-03	1.10E-02	520	Cancer Risk		520	Cancer Risk
Trichlorofluoromethane	75694	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
2,4,5-Trichlorophenol	95954	1.00E-01		200000	Noncancer Risk	40000	40000	Noncancer Risk
2,4,6-Trichlorophenol	88062		1.10E-02	520	Cancer Risk		520	Cancer Risk
2,4,5-Trichlorophenoxyacetic acid	93765	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
2-(2,4,5-Trichlorophenoxy)propionic acid	93721	8.00E-03		16000	Noncancer Risk	3200	3200	Noncancer Risk
1,1,2-Trichloropropane	598776	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
1,2,3-Trichloropropane	96184	6.00E-03	7.00E+00	0.82	Cancer Risk		0.82	Cancer Risk
1,2,3-Trichloropropene	96195	5.00E-03		10000	Noncancer Risk	2000	2000	Noncancer Risk
1,1,2-Trichloro-1,2,2- trifluoroethane	76131	3.00E+01		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Tridiphane	58138082	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Trifluralin	1582098	7.50E-03	7.70E-03	740	Cancer Risk		740	Cancer Risk
1,2,4-Trimethylbenzene	95636	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
1,3,5-Trimethylbenzene	108678	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk
Trimethyl phosphate	512561		3.70E-02	150	Cancer Risk		150	Cancer Risk
1,3,5-Trinitrobenzene	99354	5.00E-05		100	Noncancer Risk	20	20	Noncancer Risk
Trinitrophenylmethylnitramine	479458	1.00E-02		20000	Noncancer Risk	4000	4000	Noncancer Risk
2,4,6-Trinitrotoluene	118967	5.00E-04	3.00E-02	190	Cancer Risk		190	Cancer Risk
Uranium (soluble salts)	7440611	3.00E-03		6100	Noncancer Risk	1220	1220	Noncancer Risk
Vanadium	7440622	7.00E-03		14000	Noncancer Risk	2800	2800	Noncancer Risk
Vanadium pentoxide	1314621	9.00E-03		18000	Noncancer Risk	3600	3600	Noncancer Risk
Vanadium sulfate	36907423	2.00E-02		41000	Noncancer Risk	8200	8200	Noncancer Risk

APPENDIX 8. METHOD 1 S-2 TARGET CONCENTRATIONS (Industrial / Commercial Exposure)

		ORAL RfD (*)	ORAL SLOPE FACTOR (*)	EPA REGION III RISK-BASED CONC.		EPA REGION III NONCANCER RISK-BASED CONC.	METHOD I S-2 TARGET CONCENTRATIONS	
COMPOUNDS	CAS #	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$	(mg/kg)	Basis	x 0.2 (HQ)	(mg/kg)	Basis
Vernam	1929777	1.00E-03		2000	Noncancer Risk	400	400	Noncancer Risk
Vinclozolin	50471448	2.50E-02		51000	Noncancer Risk	10200	10200	Noncancer Risk
Vinyl acetate	108054	1.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Vinyl chloride	75014		1.90E+00	3	Cancer Risk		3	Cancer Risk
Warfarin	81812	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
m-Xylene	108323	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
o-Xylene	95476	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Xylene (mixed)	1330207	2.00E+00		1000000	Noncancer Risk	200000	200000	Noncancer Risk
Zinc	7440666	3.00E-01		610000	Noncancer Risk	122000	122000	Noncancer Risk
Zinc phosphide	1314847	3.00E-04		610	Noncancer Risk	122	122	Noncancer Risk
Zineb	12122677	5.00E-02		100000	Noncancer Risk	20000	20000	Noncancer Risk

(*) - Source: U.S. Environmental Protection Agency, Region III - Risk-Based Concentration Table (April 1996)

(**) - Refer to Appendix 2, Defaults and Assumptions, for discussion of target concentration determination for Alkanes and Aromatics, Dioxins and Furans, and Lead

APPENDIX 9. TABLE 1. METHOD I S-3:G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Kd (L/kg)	Ref	Koc (L/kg)	Ref	HENRY'S LAW CONSTANT (Dimensionless)	Ref	G-1 TARGET CONCEN-TRATION (mg/L)	METHOD I S-3:G-1 TARGET CONCENTRATION (mg/kg)
ACENAPHTHENE	83329			4900	a	0.00636	a	0.08	8.16
ACENAPHTHYLENE	208968			2500	c	0.05945	c	0.21	11.4
ACETONE	67641			0.575	a	0.00159	a	0.7	2.81
ACRYLAMIDE (PROPENAMIDE)	79061			0	e	1.2423E-07	e	0.00001	0.0000400
ANTHRACENE	120127			23500	a	0.00267	a	2.1	995
ARSENIC	7440382	26	a					0.05	26.2
ATRAZINE	1912249			200	f	0.000000086	j	0.003	0.0240
BARIUM	7440393	21	a					2	848
BENZENE	71432			61.7	a	0.2255	c	0.001	0.00562
BENZO (A) ANTHRACENE	56553			358000	a	0.000137	a	0.0000479	0.343
BENZO (G,H,I) PERYLENE	191242			1600000	c	0.000005904	c	0.21	6720
BIS (2-CHLOROETHYL) ETHER	111444			75.9	a	0.004633	c		
BIS (2-CHLOROISO-PROPYL) ETHER	396383329			61	c	0.004633	c		
BORON	7440428	3	d					0.32	20.5
BROMODICHLOROMETHANE	75274			55	a	0.0656	a	0.00056	0.00292
BROMOFORM (TRIBROMOMETHANE)	75252			126	a	0.0219	a	0.00019	0.00125
BROMOMETHANE	74839			5.9	c	8.077	c		
BUTYL BENZYL PHTHALATE	85687			13700	a	0.0000517	a	0.1	27.8
CADMIUM	7440439	27	a					0.005	2.72
CAPROLACTAM	105602				cd		cd	3.5	cd
CARBOFURAN	1563662			158	e	1.5908E-06	e	0.036	0.258
CARBON DISULFIDE	75150			45.7	a	1.24	a	0.7	4.94
CARBON TETRACHLORIDE	56235			152	a	1.2013	c	0.0003	0.00274
CHLORDANE	57749			51300	a	0.00199	a	0.000027	0.0278
CHLOROBENZENE	108907			224	a	0.16113	c	0.05	0.438

APPENDIX 9. TABLE 1. METHOD I S-3:G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Kd (L/kg)	Ref	Koc (L/kg)	Ref	HENRY'S LAW CONSTANT (Dimensionless)	Ref	G-1 TARGET CONCEN-TRATION (mg/L)	METHOD I S-3:G-1 TARGET CONCENTRATION (mg/kg)
CHLOROETHANE	124481			3.24	e	0.4551	e	2.8	13.6
CHLOROFORM (TRICHLOROMETHANE)	75003			52.5	a	0.13899	c	0.00019	0.00101
CHLOROPHENOL 2-	95578			397	a	0.016	a	0.0001	0.00120
CHROMIUM	7440473	27	a					0.05	27.2
CHRYSENE	218019			398000	a	0.00388	a	0.00479	38.1
CIS-1,2-DICHLOROETHENE	156592			35.5	a	0.167	a	0.07	0.350
COPPER	7440508	35	d					1	704
CYANIDE	57125	9.9	a					0.154	31.1
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE (DEHP)	117817			111000	c	0.0000418	c	0.003	6.67
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742			1570	a	3.85E-08	a	0.7	24.8
DI-N-OCTYL PHTHALATE	117840			83200000	a	0.00274	a	0.14	233000
DIBROMO-3-CHLOROPROPANE 1,2-	96128			98	b	0.01275	b	0.000025	0.000150
DICHLOROBENZENE 1,2 (O-DCB)	95501			379	a	0.07954	c	0.62	7.27
DICHLOROBENZENE 1,3 (M-DCB)	541731			1700	c	0.10783	c	0.62	23.7
DICHLOROBENZENE 1,4 (P-DCB)	106467			616	a	0.11152	c	0.075	1.24
DICHLORODIFLUOROMETHANE (FREON-12; HALON)	75718			58	b	123	e	1.4	306
DICHLOROETHANE 1,1	75343			53.4	a	0.22345	c	0.7	3.82
DICHLOROETHANE 1,2 (ETHYLENE DICHLORIDE)	107062			38	a	0.0451	c	0.00038	0.00184
DICHLOROETHENE 1,2 (TRANS)	156605			38	a	0.385	a	0.07	0.380
DICHLOROETHYLENE 1,1 (VINYLIDENE CHLORIDE)	75354			65	c	0.6109	c	0.007	0.0445
DICHLOROPHENOXY ACETIC ACID 2,4 (2,4-D)	94757			20	b	0.007708	b	0.07	0.309
DICHLOROPROPANE 1,2-	78875			47	a	0.11562	c	0.00056	0.00288
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756			27.1	a	0.1435	c	0.00019	0.000910

APPENDIX 9. TABLE 1. METHOD I S-3:G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Kd (L/kg)	Ref	Koc (L/kg)	Ref	HENRY'S LAW CONSTANT (Dimensionless)	Ref	G-1 TARGET CONCEN-TRATION (mg/L)	METHOD I S-3:G-1 TARGET CONCENTRATION (mg/kg)
DIETHYLPHTHALATE (DEP)	84662			82.2	a	0.0000185	a	5	28.2
DIOXIN 2,3,7,8-TCDD ONLY	1746016			3300000	b	0.1476	b	2.2E-10	0.0000145
DIPHENYL (BIPHENYL)	92524			1072	e	0.007913	e	0.35	8.91
DIUNDECYL PHTHALATE (SANTICIZER 711)	3648202				cd		cd	0.14	cd
ENDRIN	72208			10800	a	0.000308	a	0.002	0.440
EPICHLOROHYDRIN (1-CHLORO-2,3-EPOXYPROPANE)	106898			10	b	0.0013079	b	0.00354	0.0149
ETHYLBENZENE	100414			204	a	0.14063	c	0.029	0.241
ETHYLENE DIBROMIDE (EDB, 1,2-DIBROMOETHANE)	106934			44	c	0.027593	c	0.0000004	0.00000197
ETHYLENE GLYCOL	107211			0.0127	g	9.594E-09	k	7	28.0
FLUORANTHENE	206440			49100	a	0.00066	a	0.28	276
FLUORENE	86737			7710	a	0.00261	a	0.28	44.3
FLUORIDE	7782414		cd					2	cd
HEPTACHLOR	76448			9530	a	60.7	a	0.000008	0.00240
HEPTACHLOR EPOXIDE	1024573			83200	a	0.00039	a	0.000004	0.00667
HEPTANE	142825			5870	h	83.435	e	2.1	559
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741			80000	a	0.0541	a	0.00002	0.0321
IRON	7439896	25	d					0.3	151
ISOPROPYL ETHER (DIISOPOROPYL ETHER)	108203			31.22	g	0.40877	e	0.07	0.373
LEAD	7439921	900	d					0.015	270
LINDANE (GAMMA-BHC)	58899			1350	a	0.000574	a	0.0002	0.00620
MANGANESE	7439965	65	d					0.05	65.2
MERCURY	7439976	0.46	a			0.467	a	0.0011	0.0154
METHANOL	67561			2.75	e	0.00018204	e	3.5	14.2

APPENDIX 9. TABLE 1. METHOD I S-3:G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Kd (L/kg)	Ref	Koc (L/kg)	Ref	HENRY'S LAW CONSTANT (Dimensionless)	Ref	G-1 TARGET CONCEN-TRATION (mg/L)	METHOD I S-3:G-1 TARGET CONCENTRATION (mg/kg)
METHOXYCHLOR	72435			80000	a	0.000648	a	0.035	56.1
METHYL ETHYL KETONE (MEK; 2-BUTANONE)	78933			3.5	c	0.0011234	c	0.17	0.692
METHYL ISOBUTYL KETONE (MIBK)	108101			3.1	c	0.005658	c		
METHYL TERT-BUTYL ETHER	1634044			27	c	0.024231	c	0.2	0.916
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092			10	a	0.13079	c	0.005	0.0221
N-HEXANE	110543			1468	h	31.488	e	0.42	36.9
NAPHTHALENE	91203			1190	a	0.0198	a	0.021	0.585
NICKEL	7440020	28	a					0.1	56.4
NITRATE (AS N)	14797558		cd					10	cd
NITRITE (AS N)	14797650		cd					1	cd
OXAMYL	23135220			2.24	l	0.0000902	l	0.175	0.708
P-DIOXANE 1,4-DIETHYLENE DIOXIDE)	123911			3.47	e	0.00020008	e	0.007	0.0285
PENTACHLOROPHENOL	87865			3650	a	0.000001	a	0.0003	0.0231
PHENANTHRENE	85018			14000	c	0.0016113	c	0.21	59.6
PHENOL	108952			91	c	0.0000163	a	0.3	1.75
PYRENE	129000			68000	a	0.000451	a	0.21	286
SELENIUM	7782492	12	a					0.05	12.2
SILVER	7440224	0.42	a					0.018	0.223
SILVEX (2,4,5-TP)	93721			2570	i	3.444E-09	i	0.05	2.77
SIMAZINE	122349			138	l	1.394E-07	l	0.0035	0.0237
STYRENE (ETHENYLBENZENE)	100425			912	a	0.10701	c	0.1	2.24
SULFATE	4808798		cd					250	cd
TETRACHLOROETHANE 1,1,1,2-	630206			54	c	0.451	c		
TETRACHLOROETHANE 1,1,2,2-	79345			79	a	0.01558	c		

APPENDIX 9. TABLE 1. METHOD I S-3:G-1 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	Kd (L/kg)	Ref	Koc (L/kg)	Ref	HENRY'S LAW CONSTANT (Dimensionless)	Ref	G-1 TARGET CONCEN-TRATION (mg/L)	METHOD I S-3:G-1 TARGET CONCENTRATION (mg/kg)
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184			265	a	0.754	a	0.0007	0.00742
TOLUENE (METHYLBENZENE)	108883			140	a	0.27388	c	1	7.27
TOXAPHENE	8001352			95800	a	0.000246	a	0.000031	0.0595
TRICHLOROBENZENE 1,2,4-	120821			1660	a	0.05822	c		
TRICHLOROETHANE 1,1,1 (METHYL CHLOROFORM)	71556			135	a	0.9471	c	0.2	1.67
TRICHLOROETHANE 1,1,2-	79005			75	a	0.03731	c		
TRICHLOROETHYLENE (TCE)	79016			94.3	a	0.37392	c	0.0028	0.0183
TRICHLOROFLUORO-METHANE	75694			158	e	4.51	e	2.1	31.5
VINYL CHLORIDE (CHLOROETHYLENE)	75014			18.6	a	1.1398	c	0.000015	0.0000952
XYLENES (O-, M-, AND P-)	1330207			249	a	0.21607	c	0.53	4.96
ZINC	7440666	26	a					2.1	1100

a USEPA, 1996, Soil screening guidance: Technical background document: EPA/540/R95/128
b USEPA, 1986, Superfund public health evaluation manual: Office of Emergency and Remedial Response
c Massachusetts Department of Environmental Protection, 1994, Background documentation for the development of the MCP numerical standards
d Baes, C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984, A review and analysis of parameters for assessing transport of environmentally released radionuclides through agriculture: Oak Ridge National Laboratory
e Monomery, J.H., 1996, Groundwater chemicals desk reference: CRC Press, Inc.
f Lymen, W.J., W.F. Reehl, D.H. Rosenblat, 1990, Handbook of chemical property estimation methods: American Chemical Society
g Calculated using equation (70) in reference (a)
h Calculated using equation (71) in reference (a)
i Sims, R.C., J.L. Sims, and S.G. Hansen, 1991, Soil transport and fate database, version 2.0: USEPA Robert S. Kerr Environmental Research Laboratory
j Calculated using equation (63) in reference (a)
k ABDR Toxicity Profile, 1993
l Monomery, J.H., 1993, Agrochemical desk reference environmental data: Lewis Publishers, Chelsea, MI

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
ACENAPHTHENE	83329			4900	a	0.00636	a		
ACENAPHTHYLENE	208968			2500	c	0.05945	c		
ACETONE	67641			0.575	a	0.00159	a		
ACRYLAMIDE (PROPENAMIDE)	79061			0	e	1.2423E-07	e		
ANTHRACENE	120127			23500	a	0.00267	a		
ARSENIC	7440382	26	a						
ATRAZINE	1912249			200	f	8.6E-08	j		
BARIUM	7440393	21	a						
BENZENE	71432			61.7	a	0.2255	c	0.01027	0.0578
BENZO (A) ANTHRACENE	56553			358000	a	0.000137	a		
BENZO (G,H,I) PERYLENE	191242			1600000	c	5.904E-06	c		
BIS (2-CHLOROETHYL) ETHER	111444			75.9	a	0.004633	c	0.10862	0.599
BIS (2-CHLOROISO-PROPYL) ETHER	396383329			61	c	0.004633	c	0.41416	2.17
BORON	7440428	3	d						
BROMODICHLOROMETHANE	75274			55	a	0.0656	a		
BROMOFORM (TRIBROMOMETHANE)	75252			126	a	0.0219	a		
BROMOMETHANE	74839			5.9	c	8.077	c	0.00238	0.0431
BUTYL BENZYL PHTHALATE	85687			13700	a	0.0000517	a		
CADMIUM	7440439	27	a						
CAPROLACTAM	105602				cd		cd		cd,
CARBOFURAN	1563662			158	e	1.5908E-06	e		
CARBON DISULFIDE	75150			45.7	a	1.24	a		

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
CARBON TETRACHLORIDE	56235			152	a	1.2013	c	0.00106	0.00861
CHLORDANE	57749			51300	a	0.00199	a		
CHLOROBENZENE	108907			224	a	0.16113	c	0.47598	3.04
CHLOROETHANE	124481			3.24	e	0.4551	e		
CHLOROFORM (TRICHLOROMETHANE)	75003			52.5	a	0.13899	c	0.006	0.0173
CHLOROPHENOL 2-	95578			397	a	0.016	a		
CHROMIUM	7440473	27	a						
CHRYSENE	218019			398000	a	0.00388	a		
CIS-1,2-DICHLOROETHENE	156592			35.5	a	0.167	a		
COPPER	7440508	35	d						
CYANIDE	57125	9.9	a						
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE (DEHP)	117817			111000	c	0.0000418	c		
DI-N-BUTYL (OR DIBUTYL) PHTHALATE (DBP)	84742			1570	a	3.85E-08	a		
DI-N-OCTYL PHTHALATE	117840			83200000	a	0.00274	a		
DIBROMO-3-CHLOROPROPANE 1,2-	96128			98	b	0.01275	b		
DICHLOROBENZENE 1,2 (O-DCB)	95501			379	a	0.07954	c	6.75464	79.1
DICHLOROBENZENE 1,3 (M-DCB)	541731			1700	c	0.10783	c		
DICHLOROBENZENE 1,4 (P-DCB)	106467			616	a	0.11152	c	27.581	455
DICHLORODIFLUOROMETHANE (FREON-12; HALON)	75718			58	b	123	e		
DICHLOROETHANE 1,1	75343			53.4	a	0.22345	c	8.59574	46.9
DICHLOROETHANE 1,2 (ETHYLENE DICHLORIDE)	107062			38	a	0.0451	c	0.01636	
DICHLOROETHENE 1,2 (TRANS)	156605			38	a	0.385	a		

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
DICHLOROETHYLENE 1,1 (VINYLIDENE CHLORIDE)	75354			65	c	0.6109	c	0.00063	0.00401
DICHLOROPHENOXY ACETIC ACID 2,4 (2,4-D)	94757			20	b	0.007708	b		
DICHLOROPROPANE 1,2-	78875			47	a	0.11562	c	0.13243	0.681
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756			27.1	a	0.1435	c	0.0036	0.0172
DIETHYLPHTHALATE (DEP)	84662			82.2	a	0.0000185	a		
DIOXIN 2,3,7,8-TCDD ONLY	1746016			3.3E+6	b	0.1476	b		
DIPHENYL (BIPHENYL)	92524			1072	e	0.007913	e		
DIUNDECYL PHTHALATE (SANTICIZER 711)	3648202				cd		cd		cd,
ENDRIN	72208			10800	a	0.000308	a		
EPICHLOROHYDRIN (1-CHLORO-2,3-EPOXYPROPANE)	106898			10	b	0.0013079	b		
ETHYLBENZENE	100414			204	a	0.14063	c	27.3159	227
ETHYLENE DIBROMIDE (EDB, 1,2-DIBROMOETHANE)	106934			44	c	0.027593	c	0.00316	0.002
ETHYLENE GLYCOL	107211			0.0127	g	9.594E-09	k		
FLUORANTHENE	206440			49100	a	0.00066	a		
FLUORENE	86737			7710	a	0.00261	a		
FLUORIDE	7782414		cd						cd,
HEPTACHLOR	76448			9530	a	60.7	a		
HEPTACHLOR EPOXIDE	1024573			83200	a	0.00039	a		
HEPTANE	142825			5870	h	83.435	e		
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741			80000	a	0.0541	a		
IRON	7439896	25	d						

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
ISOPROPYL ETHER (DIISOPOROPYL ETHER)	108203			31.22	g	0.40877	e		
LEAD	7439921	900	d						
LINDANE (GAMMA-BHC)	58899			1350	a	0.000574	a		
MANGANESE	7439965	65	d						
MERCURY	7439976	0.46	a			0.467	a		
METHANOL	67561			2.75	e	1.8204E-4	e		
METHOXYCHLOR	72435			80000	a	0.000648	a		
METHYL ETHYL KETONE (MEK; 2-BUTANONE)	78933			3.5	c	0.0011234	c	170	692
METHYL ISOBUTYL KETONE (MIBK)	108101			3.1	c	0.005658	c	54	220
METHYL TERT-BUTYL ETHER	1634044			27	c	0.024231	c	200	916
METHYLENE CHLORIDE (DICHLOROMETHANE)	75092			10	a	0.13079	c	0.3131	1.39
N-HEXANE	110543			1468	h	31.488	e		
NAPHTHALENE	91203			1190	a	0.0198	a		
NICKEL	7440020	28	a						
NITRATE (AS N)	14797558		cd						cd,
NITRITE (AS N)	14797650		cd						cd,
OXAMYL	23135220			2.24	l	0.0000902	l		
P-DIOXANE 1,4-DIETHYLENE DIOXIDE)	123911			3.47	e	0.00020008	e		
PENTACHLOROPHENOL	87865			3650	a	0.000001	a		
PHENANTHRENE	85018			14000	c	0.0016113	c		
PHENOL	108952			91	c	0.0000163	a		
PYRENE	129000			68000	a	0.000451	a		
SELENIUM	7782492	12	a						

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
SILVER	7440224	0.42	a						
SILVEX (2,4,5-TP)	93721			2570	i	3.444E-09	i		
SIMAZINE	122349			138	l	1.394E-07	l		
STYRENE (ETHENYLBENZENE)	100425			912	a	0.10701	c	35.8979	805
SULFATE	4808798		cd						cd,
TETRACHLOROETHANE 1,1,1,2-	630206			54	c	0.451	c	0.00575	0.0337
TETRACHLOROETHANE 1,1,2,2-	79345			79	a	0.01558	c	0.02123	0.119
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184			265	a	0.754	a	0.39554	4.20
TOLUENE (METHYLBENZENE)	108883			140	a	0.27388	c	5.59078	40.7
TOXAPHENE	8001352			95800	a	0.000246	a		
TRICHLOROBENZENE 1,2,4-	120821			1660	a	0.05822	c	9.5	354
TRICHLOROETHANE 1,1,1 (METHYL CHLOROFORM)	71556			135	a	0.9471	c	4.056	33.8

APPENDIX 9. TABLE 2. METHOD I S-3:G-2 TARGET CONCENTRATIONS

COMPOUND	CAS #	Kd (L/kg)	Ref	Koc	Ref	HENRY'S LAW CONSTANT	Ref	G-2 Target Groundwater Concentration (mg/L)	METHOD I S-3:G-2 TARGET CONCENTRATION (mg/kg)
TRICHLOROETHANE 1,1,2-	79005			75	a	0.03731	c	0.03214	0.179
TRICHLOROETHYLENE (TCE)	79016			94.3	a	0.37392	c	0.02993	0.196
TRICHLOROFLUORO-METHANE	75694			158	e	4.51	e		
VINYL CHLORIDE (CHLOROETHYLENE)	75014			18.6	a	1.1398	c	0.00002	0.000127
XYLENES (O-, M-, AND P-)	1330207			249	a	0.21607	c	5.32739	49.8
ZINC	7440666	26	a						

a USEPA, 1996, Soil screening guidance: Technical background document: EPA/540/R95/128
b USEPA, 1986, Superfund public health evaluation manual: Office of Emergency and Remedial Response
c Massachusetts Department of Environmental Protection, 1994, Background documentation for the development of the MCP numerical standards
cd Chemical-specific data unavailable
d Baes, C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984, A review and analysis of parameters for assessing transport of environmentally released radionuclides through agriculture: Oak Ridge National Laboratory
e Monomery, J.H., 1996, Groundwater chemicals desk reference: CRC Press, Inc.
f Lymen, W.J., W.F. Reehl, D.H. Rosenblat, 1990, Handbook of chemical property estimation methods: American Chemical Society
g Calculated using equation (70) in reference (a)
h Calculated using equation (71) in reference (a)
i Sims, R.C., J.L. Sims, and S.G. Hansen, 1991, Soil transport and fate database, version 2.0: USEPA Robert S. Kerr Environmental Research Laboratory
j Calculated using equation (63) in reference (a)
k ABDR Toxicity Profile, 1993
l Monomery, J.H., 1993, Agrochemical desk reference environmental data: Lewis Publishers, Chelsea, MI
Target groundwater concentration not determined

APPENDIX 9. TABLE 3. METHOD I S-3:G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	G-3 250 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (250 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 500 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (500 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 1000 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (1000 ft) TARGET CONCENTRATIONS (mg/kg)
ACENAPHTHENE	83329	1.71E+00	1.74E+02	1.71E+00	1.74E+02	1.71E+00	1.74E+02
ANTHRACENE	120127	6.45E-01	3.06E+02	6.45E-01	3.06E+02	6.45E-01	3.06E+02
ARSENIC	7440382	1.25E-01	6.55E+01	2.50E-01	1.31E+02	5.00E-01	2.62E+02
BENZENE	71432	1.79E-01	1.00E+00	3.57E-01	2.01E+00	7.14E-01	4.02E+00
BENZO (A) ANTHRACENE	56553	1.23E-04	8.78E-01	2.45E-04	1.76E+00	4.90E-04	3.51E+00
BENZO (G,H,I) PERYLENE	191242	1.23E-04	3.92E+00	1.30E-04	4.16E+00	1.30E-04	4.16E+00
BIS (2-CHLOROETHYL) ETHER	111444	5.10E-05	2.81E-04	5.10E-05	2.81E-04	5.10E-05	2.81E-04
BORON	7440428	1.88E+00	1.20E+02	3.75E+00	2.40E+02	7.50E+00	4.80E+02
BROMODICHLOROMETHANE	75274	1.15E-01	6.00E-01	2.30E-01	1.20E+00	4.60E-01	2.40E+00
BROMOFORM (TRIBROMOMETHANE)	75252	1.90E-01	1.25E+00	1.90E-01	1.25E+00	1.90E-01	1.25E+00
BROMOMETHANE	74839	1.00E+01	1.81E+02	2.00E+01	3.62E+02	4.00E+01	7.25E+02
CADMIUM	7440439	5.00E-03	2.72E+00	1.00E-02	5.44E+00	2.00E-02	1.09E+01
CARBON TETRACHLORIDE	56235	1.11E-02	1.01E-01	2.21E-02	2.02E-01	4.42E-02	4.03E-01
CHLORDANE	57749	1.47E-06	1.51E-03	2.94E-06	3.03E-03	5.88E-06	6.06E-03
CHLOROBENZENE	108907	5.00E+01	4.38E+02	5.00E+01	4.38E+02	5.00E+01	4.38E+02
CHLOROETHANE	124481	8.50E-02	4.13E-01	1.70E-01	8.25E-01	3.40E-01	1.65E+00
CHRYSENE	218019	1.23E-04	9.76E-01	2.45E-04	1.95E+00	4.90E-04	3.90E+00
COPPER	7440508	7.50E-03	5.28E+00	1.50E-02	1.06E+01	3.00E-02	2.11E+01
CYANIDE	57125	2.50E-03	5.05E-01	5.00E-03	1.01E+00	1.00E-02	2.02E+00
DI (OR BIS) 2-ETHYLHEXYL PHTHALATE	117817	1.48E-02	3.29E+01	2.96E-02	6.58E+01	5.92E-02	1.32E+02
DI-N-BUTYL (OR DIBUTYL) PHTHALATE	84742	3.00E+01	1.06E+03	6.00E+01	2.12E+03	1.20E+02	4.25E+03
DICHLOROBENZENE 1,2 (O-DCB)	95501	4.25E+01	4.98E+02	7.25E+01	8.50E+02	7.25E+01	8.50E+02

APPENDIX 9. TABLE 3. METHOD I S-3:G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	G-3 250 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (250 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 500 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (500 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 1000 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (1000 ft) TARGET CONCENTRATIONS (mg/kg)
DICHLOROBENZENE 1,3 (M-DCB)	541731	6.50E+00	2.48E+02	1.30E+01	4.96E+02	2.60E+01	9.93E+02
DICHLOROETHANE 1,2 DICHLORIDE)	107062	2.48E-01	1.20E+00	3.80E-01	1.84E+00	3.80E-01	1.84E+00
DICHLOROETHYLENE 1,1	75354	8.00E-03	5.09E-02	1.60E-02	1.02E-01	3.20E-02	2.03E-01
DICHLOROPROPENE 1,3 (CIS AND TRANS)	542756	1.90E-01	9.10E-01	1.90E-01	9.10E-01	1.90E-01	9.10E-01
DIETHYLPHTHALATE (DEP)	84662	3.00E+02	1.69E+03	6.00E+02	3.39E+03	1.20E+03	6.77E+03
DIOXIN 2,3,7,8-TCDD ONLY	1746016	3.50E-08	2.31E-03	7.00E-08	4.62E-03	1.40E-07	9.24E-03
ENDRIN	72208	5.00E-06	1.10E-03	1.00E-05	2.20E-03	2.00E-05	4.40E-03
ETHYLBENZENE	100414	2.90E+01	2.41E+02	2.90E+01	2.41E+02	2.90E+01	2.41E+02
FLUORANTHENE	206440	1.33E-01	1.31E+02	1.33E-01	1.31E+02	1.33E-01	1.31E+02
FLUORENE	86737	9.50E-01	1.50E+02	9.50E-01	1.50E+02	9.50E-01	1.50E+02
HEPTACHLOR	76448	5.35E-07	1.60E-04	1.07E-06	3.21E-04	2.14E-06	6.42E-04
HEPTACHLOR EPOXIDE	1024573	2.75E-07	4.59E-04	5.50E-07	9.17E-04	1.10E-06	1.83E-03
HEXACHLOROBENZENE (PERCHLOROBENZENE)	118741	1.93E-06	3.09E-03	3.85E-06	6.18E-03	7.70E-06	1.24E-02
IRON	7439896	2.50E+00	1.26E+03	5.00E+00	2.52E+03	1.00E+01	5.04E+03
LEAD	7439921	6.25E-02	1.13E+03	1.25E-01	2.25E+03	2.50E-01	4.50E+03
LINDANE (GAMMA-BHC)	58899	1.00E-05	3.10E-04	2.00E-05	6.20E-04	4.00E-05	1.24E-03
MANGANESE	7439965	2.50E-01	3.26E+02	5.00E-01	6.52E+02	1.00E+00	1.30E+03
MERCURY	7439976	3.00E-05	4.20E-04	6.00E-05	8.41E-04	1.20E-04	1.68E-03
METHOXYCHLOR	72435	7.50E-05	1.20E-01	1.50E-04	2.41E-01	3.00E-04	4.81E-01
METHYLENE CHLORIDE	75092	4.00E+00	1.77E+01	5.00E+00	2.21E+01	5.00E+00	2.21E+01
NICKEL	7440020	2.08E-02	1.17E+01	4.15E-02	2.34E+01	8.30E-02	4.68E+01

APPENDIX 9. TABLE 3. METHOD I S-3:G-3 TARGET CONCENTRATIONS

COMPOUNDS	CAS #	G-3 250 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (250 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 500 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (500 ft) TARGET CONCENTRATIONS (mg/kg)	G-3 1000 feet TARGET GROUNDWATER CONCENTRATION (mg/L)	METHOD I S3:G3 (1000 ft) TARGET CONCENTRATIONS (mg/kg)
PENTACHLOROPHENOL	87865	1.98E-02	1.52E+00	3.95E-02	3.04E+00	7.90E-02	6.08E+00
PHENANTHRENE	85018	7.25E-02	2.06E+01	1.45E-01	4.12E+01	2.90E-01	8.24E+01
PHENOL	108952	3.00E+02	1.75E+03	3.00E+02	1.75E+03	3.00E+02	1.75E+03
PYRENE	129000	8.00E-02	1.09E+02	8.00E-02	1.09E+02	8.00E-02	1.09E+02
SELENIUM	7782492	1.25E-02	3.05E+00	2.50E-02	6.10E+00	5.00E-02	1.22E+01
SILVER	7440224	1.50E-04	1.86E-03	3.00E-04	3.72E-03	6.00E-04	7.44E-03
SILVEX (2,4,5-TP)	93721	1.48E-06	8.17E-05	2.95E-06	1.63E-04	5.90E-06	3.27E-04
TETRACHLOROETHANE 1,1,2,2-	79345	2.70E-02	1.51E-01	5.40E-02	3.03E-01	1.08E-01	6.06E-01
TETRACHLOROETHYLENE (PERCHLOROETHYLENE; PCE)	127184	2.21E-02	2.35E-01	4.43E-02	4.69E-01	8.85E-02	9.39E-01
TOLUENE (METHYLBENZENE)	108883	2.75E-02	2.00E-01	5.50E-02	4.00E-01	1.10E-01	8.00E-01
TOXAPHENE	8001352	5.00E-07	9.60E-04	1.00E-06	1.92E-03	2.00E-06	3.84E-03
TRICHLOROETHANE 1,1,2-	79005	1.05E-01	5.84E-01	2.10E-01	1.17E+00	4.20E-01	2.34E+00
TRICHLOROETHYLENE (TCE)	79016	2.31E-01	1.51E+00	4.62E-01	3.02E+00	9.24E-01	6.04E+00
VINYL CHLORIDE (CHLOROETHYLENE)	75014	1.50E-02	9.52E-02	1.50E-02	9.52E-02	1.50E-02	9.52E-02
ZINC	7440666	1.25E-01	6.55E+01	2.50E-01	1.31E+02	5.00E-01	2.62E+02

1 Geochemical data used in calculations are contained in Appendix 9, Tables 1 and 2.

APPENDIX 10.

GROUNDWATER MODELING GUIDELINES FOR CONDUCTING RISK ASSESSMENTS

Introduction

In assessing risk from contaminated sites, one tool available to investigators is groundwater modeling. A model allows an investigator to estimate the movement of pollutants away from a site by solving equations describing fluid flow and pollutant transport. To effectively use a model, the investigator should have a basic understanding of how the model works, what are the model's data requirements and limitations, and how appropriate is the model for a particular site. The dual purpose of these guidelines is to: (1) provide guidance to investigators in selecting and using appropriate models; and (2) provide a checklist for regulators to use in evaluating the adequacy of modeling results submitted by investigators. The final report documenting modeling results must be sealed by a registered Professional Engineer or Geologist.

These guidelines refer exclusively to saturated, isothermal groundwater flow models, and are based on the following guides published by the American Society for Testing and Materials (ASTM): D 5447-93; D 5609-94; D 5610-94; D 5490-93; and D 5611-94. The ASTM guides provide more in-depth information on groundwater modeling, and should be consulted by those lacking strong modeling skills. By its nature groundwater modeling must be site specific, and site characterization must precede selection of an appropriate groundwater model. The DWQ Groundwater Section does not recommend particular models, but does require that any model used on a State-regulated project: (1) be thoroughly documented in readily accessible published format; (2) be peer-reviewed in the scientific literature [includes appropriate government publications and reviews published by or in cooperation with the International Ground Water Modeling Center]; (3) be available in the public domain in source code format [preferred but not required] ; and (4) be appropriate to the site under investigation, as determined by these guidelines. The guidelines are primarily concerned with saturated groundwater flow, which must be adequately characterized before transport and attenuation processes can be evaluated. Also, the guidelines do not address unsaturated flow and transport processes. As ASTM guides are developed for transport, attenuation, and unsaturated flow processes, the DWQ Groundwater Section modeling guidelines will be expanded.

The guidelines are divided into two sections. The first section describes the groundwater modeling process and the steps that should be followed in characterizing a site, selecting and calibrating a model, and conducting model simulations. The second section discusses the individual components that should be included in a final report documenting model results.

Ground-Water Modeling Process

The groundwater modeling process involves seven steps, as illustrated in Figure 1. These steps are discussed individually in the following paragraphs. Documentation of the modeling process and report preparation is outlined in the next section.

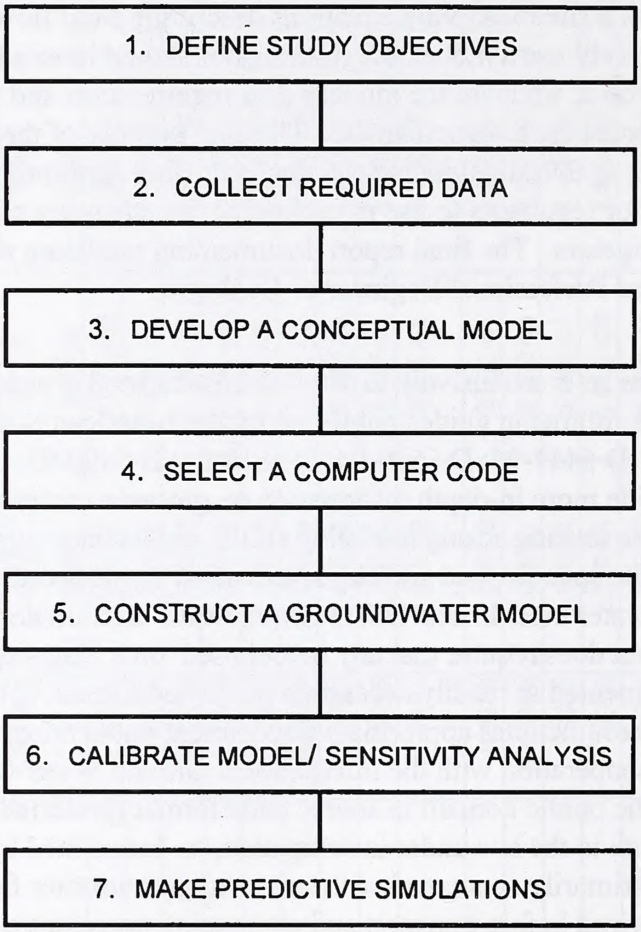
1. DEFINE STUDY OBJECTIVES
2. COLLECT REQUIRED DATA
3. DEVELOP A CONCEPTUAL MODEL
4. SELECT A COMPUTER CODE
5. CONSTRUCT A GROUNDWATER MODEL
6. CALIBRATE MODEL/ SENSITIVITY ANALYSIS
7. MAKE PREDICTIVE SIMULATIONS

Figure 1. Steps in the Ground-Water Modeling Process

1. **Define study objectives.** In this critical first step, complete and detailed objectives of the modeling effort are specified. These objectives will dictate the level of detail and accuracy required in model simulation. These objectives should:

- Adequately address any regulatory requirements.
- Identify constituents and processes to be modeled and acceptable model assumptions to be made.
- Provide acceptable tolerances for model calibration.

2. **Collect required data.** Data collection includes assembling background data on the site, identifying the nature and extent of all contaminants, identifying all possible receptors in the surrounding area, and characterizing the geologic, hydrologic, and meteorological setting.
    - Detailed county soils map, 1:24,000 USGS topographic map, and any other project maps should be assembled to regionally locate the site and designate contaminant and receptor locations.
    - Published reports describing the regional hydrogeology should be reviewed.
    - Rainfall data from nearby weather stations should be obtained to determine the nature of rainfall patterns and estimate groundwater recharge. The availability of groundwater recharge maps from the DWQ Groundwater Section should be investigated.
    - Streamflow records from nearby gauging stations should be reviewed to determine variability in flow if the risk to a stream is being modeled.
    - A sufficient number of bore holes should be drilled at the site to characterize site stratigraphy, existing lithologies, and depth to bedrock or confining layers.
    - Sufficient wells or piezometers should be installed to determine prevailing hydraulic gradients in the area, both horizontally and vertically, and an assessment should be made as to how these gradients may vary seasonally and over time.
    - An inventory of sources and sinks within the area should be made, and records obtained from any major sources withdrawing water from modeled aquifers.
    - One or more aquifer tests of 24-hour minimum duration with sufficient observation wells to characterize horizontal and vertical isotropy is the preferred method for determining aquifer parameters. Depending on the nature of the contaminants and investigation objectives, slug tests or other such methods may be adequate to estimate aquifer parameters. Note: textbook values for risk-assessment modeling will not be acceptable.
    - Sufficient testing of the contaminants should be conducted to characterize the nature of each pollutant, concentrations at the source, and current migration patterns within the aquifer.

3. **Develop a conceptual model.** A conceptual model of groundwater flow is an interpretation or working description of the characteristics and dynamics of the

physical hydrogeologic system. This is also a critical step in the modeling process, for if the investigator incorrectly conceptualizes the hydrogeologic environment, then model results will not provide the type of information needed to accomplish study objectives. The purpose of the conceptual model is to consolidate site and regional hydrogeologic and hydrologic data into a set of assumptions and concepts that can be evaluated quantitatively. The conceptual model will also guide the investigator in proper code selection. The components of the conceptual model, described below, can be illustrated using contour maps, cross sections, block diagrams, and channel networks. It is essential that the uncertainty associated with each property or component of the conceptual model be quantitatively estimated.

- *Geologic framework.* The geologic framework describes the distribution, configuration, and physical structure of aquifers and confining units. Important factors to consider are the thickness and continuity of units, representative lithologies within units, and the unit's geologic structure.
- *Hydrologic framework.* The hydrologic framework describes the movement of water and other fluids within the geologic framework. Factors to consider are: whether flow is primarily through porous media, fractures, or solution cavities; what hydraulic boundaries exist within the flow domain; what are the horizontal and vertical hydraulic gradients within the system; how is fluid potential or head distributed and how does it vary over time, what is the rate and direction of predominant groundwater flow; what do the flow lines look like and do they change over time; and do groundwater divides exist within the area and are they stable over time?
- *Hydraulic properties.* Hydraulic properties include the transmissive and storage characteristics of the aquifer system, such as transmissivity, hydraulic conductivity, storativity, and specific yield. Field and laboratory measurements of these properties should be documented, compared to accepted ranges for the medium under investigation, and uncertainty associated with the property measurements estimated. An assessment of heterogeneity and anisotropy over the aquifer domain for each property should be made, and the associated uncertainty also estimated.
- *Sources and sinks.* Sources and sinks influence groundwater flow patterns, and their effects should be documented for inclusion in the selected model. Common sources and sinks that should be identified include: pumping or injection wells, infiltration, evapotranspiration, drains, leakage across confining layers, and flow to or from surface water bodies. Descriptions of sources and sinks should include rates and temporal variability. Development of a water budget is sometimes helpful to quantify the contributions of sources and sinks.
- *Data deficiencies and uncertainty.* A final component of the conceptual model is the documentation of data deficiencies, a compilation of the

uncertainties recorded for each of the other components, and an acknowledgment of any alternative conceptual models that could be developed from the available data. This last component of the conceptual model is an important step, for it forces the investigator to quantitatively address the adequacy of the data collection effort. If high uncertainty is associated with the conceptual model, then an elaborate and costly modeling effort may not be justified.

4. **Select a computer code.** A computer code or model is a set of one or more software algorithms that simulate the characteristics of a physical hydrogeologic system. The code selected should be appropriate for the conceptual model developed. Modeling objectives should provide guidance on the complexity of model required. In general, the simpler the model, the more cost effective the modeling process. If an analytic model will satisfactorily simulate flow in the conceptual domain and meet modeling objectives, then there is no need to invest in more expensive numerical modeling. If the problem can be conceptualized in two dimensions, then a three-dimensional model is unnecessary. In selecting an appropriate model, an investigator should also consider the capabilities of staff. If staff lack training and experience in groundwater modeling, then development of a complex model should probably not be attempted.

   When selecting a groundwater computer model, the user should consider the track record of the code. A well documented modeling package that has been field tested by a number of workers and documented in the literature is recommended. In addition, part of the model verification process for numerical models should include the comparison of the numerical model results to analytical model results.

5. **Construct a groundwater model.** Model construction is the process of transforming the conceptual model into mathematical form. This process usually involves dividing or discretizing the flow domain into discrete units, identifying a period of time for analysis and discretizing this range, and compiling a data set for the groundwater computer model, including initial and boundary conditions and hydraulic properties.
6. **Calibrate model, conduct sensitivity analysis.** A reliable groundwater model must be able to simulate the actual movement of ground water. Typically a model is calibrated by comparing model output, such as a water level or head, with actual measured values. Sensitivity analysis involves varying values for a property, such as hydraulic conductivity, and observing how sensitive model results are to these changes.
7. **Make predictive simulations.** This final step involves actually running the calibrated model over some future time period to predict what contaminant concentrations may be at given locations and future times.

Reporting Modeling Results

If potential risk from a contamination site is to be assessed, results from groundwater modeling efforts must be adequately documented. Such documentation must provide decision makers sufficient information to determine the adequacy of the model and supporting data, and validity of the modeling results. These guidelines recommend a standard format for presenting results of a modeling investigation. This format is outlined in Figure 2. This format is taken directly from ASTM D 5447. The value of this format is that it standardizes criteria which should be considered in any modeling effort. The detail provided within the format should reflect the investment that has gone into the modeling effort.

1.0 Introduction
  1.1 General Setting
  1.2 Study Objectives

2.0 Conceptual Model
  2.1 Aquifer System Framework
  2.2 Ground-Water Flow System
  2.3 Hydrologic Boundaries
  2.4 Hydraulic Boundaries
  2.5 Sources and Sinks
  2.6 Water Budget

3.0 Computer Code
  3.1 Code Selection
  3.2 Code Description

4.0 Ground-Water Flow Model Construction
  4.1 Model Grid
  4.2 Hydraulic Parameters
  4.3 Boundary Conditions
  4.4 Selection of Calibration Targets

5.0 Calibration
  5.1 Residual Analysis
  5.2 Sensitivity Analysis
  5.3 Model Verification

6.0 Predictive Simulations

7.0 Summary and Conclusions
  7.1 Model Assumptions/Limitations
  7.2 Model Predictions
  7.3 Recommendations

8.0 References

Appendices: Model Input Files

Figure 2. Recommended Ground-Water Modeling Report Format

References

ASTM Guide D 5447-93. Standard guide for application of a groundwater flow model to a site-specific problem.

ASTM Guide D 5490-93. Standard guide for comparing groundwater flow model simulations to site-specific information.

ASTM Guide D 5609-94. Standard guide for defining boundary conditions in groundwater flow modeling.

ASTM Guide D 5610-94. Standard guide for defining initial conditions in groundwater flow modeling.

ASTM Guide D 5611-94. Standard guide for conducting a sensitivity analysis for a groundwater flow model application.

Water Science and Technology Board, Committee on Ground Water Modeling Assessment, Commission on Physical Sciences, Mathematics, and Resources, National Research Council. 1990. **Ground Water Models: Scientific and Regulatory Applications.** National Academy Press, Washington D.C., 305 pp.

APPENDIX 11. DATA COLLECTION REQUIREMENTS

1. **General Information** - The remediating party must provide general information that defines and describes the site and surrounding area. The remediating party should include a site location map based on a U.S.G.S. topographic map depicting 1/4 mile (1500 foot) radius from the site boundaries. The locations of the properties, residences, water supplies, institutions, natural resource areas, etc. requested below, should be keyed to this map.
   a. The Department release tracking number(s) (e.g., Federal EPA I.D. Number, Groundwater Incident Number) applicable to the site under investigation;
   b. the address(es) and geographical location of the site and/or properties comprising the site including latitude and longitude of the site;
   c. a general description of land uses surrounding the site and the names and addresses of the adjacent property owners;
   d. an estimate of the number of residents and workers at the site;
   e. an estimate of the residential population within 1/4 mile radius of the site boundaries;
   g. the number and type of institutions (e.g., schools, hospitals, day care centers) within 1/4 mile of the site boundaries;
   h. a listing and description of any of the following natural resource areas located within 1/4 mile of the site boundaries:
      i. all surface waters including wetlands, vernal pools, ponds, lakes, streams, rivers and reservoirs.
      ii. all surface water intakes used for public water supplies and public water supply wells (public water supply wells and wellhead protection areas must be identified within a 2-mile radius around the site).
      iii. all private water supply wells and irrigation wells. [Responsible parties must document that they have canvassed the surrounding area (door-to-door) to confirm the presence or absence of these wells.]
      iv. all environmentally sensitive areas listed below. Also listed are the telephone contacts that must be made to identify these areas. These telephone contacts and the information obtained must be documented.
         - Marine sanctuaries [NOAA (202) 606-4126];
         - National and State Parks [NC Division of Parks and Recreation-National Heritage Program (NC Parks) (919) 733-7701];
         - Designated and Proposed Federal and State Wilderness and Natural Areas [NC Parks (919) 733-7701];
         - Areas of Environmental Concern as identified by the Wildlife Resources Commission (G.S. 113A-113 and 15 NCAC 7I) [NC Wildlife Resources Commission (919) 288-5738];
         - Endangered or Threatened Species Habitat as identified by the Wildlife Resources Commission (WRC) and the Department of Agriculture [NC Parks (919) 733-7701]
         - Water Supply Watersheds as identified by the DWQ [NC DWQ Water Quality Section (919) 733-5083];
         - National Monuments [US Park Service (202) 343-7014];

- National and State Historical Sites [NC Dept. Of Cultural Resources (919) 733-5722];
- National and State Seashore, Lakeshore and River Recreational Areas [NC Division of Parks and Recreation - Planning and Development Section (919) 846-9991];
- Federally designated or proposed endangered or threatened species or species under review as to their endangered or threatened status [NC Parks (919) 733-7701];
- High Quality Waters, Outstanding Resource Waters, and Shellfishing Waters as identified by the DWQ [NC DWQ Water Quality Section (919) 733-5083];
- Natural Heritage Priority Areas as identified by the Division of Parks and Recreation Natural Heritage Program [NC Parks (919) 733-7701];
- National and State Preserves and Forests [NC Parks (919) 733-7701];
- National and State Wildlife Refuges [NC Parks (919) 733-7701];
- Coastal Barriers and Units of a Coastal Barrier Resources System [NC Division of Coastal Management (919) 733-2293];
- Federal land designated for protection of natural ecosystems [NC Parks (919) 733-7701];
- Spawning areas critical for the maintenance of fish/shellfish species within river, lake or coastal tidal waters as identified by the Division of Marine Fisheries and the WRC [NC Wildlife Resources Commission (919) 288-5738];
- Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which such fish spend extended periods of time as identified by the DMF and the WRC [NC Wildlife Resources Commission (919) 288-5738];
- Terrestrial areas utilized for breeding by large or dense aggregations of animals [NC Parks (919) 733-7701];
- State or Federally designated Scenic or Wild Rivers [NC Division of Parks and Recreation - Planning and Development Section (919) 846-9991];
- State lands designated for wildlife or game management [NC Wildlife Resources Commission (919) 288-5738]; and
- Wetlands [US Army Corps of Engineers (919) 847-1707].

2. **Site Information** - The remediating party should provide one or more maps or plans depicting the following on-site locations:
   a. site boundaries, roads, easements, rights of way, pavements;
   b. all perennial and non-perennial surface water features, drainage ditches, etc.;
   c. all water supply wells and irrigation wells;
   d. all environmentally sensitive areas located on-site [see Section 1.h.iv of this appendix for a listing]; and
   e. the following structures, areas, and monitoring points, as appropriate;
      i. buildings;
      ii. floor and storm drains;
      iii. basements;
      iv. subsurface utilities serving or transecting the site;
      v. septic tanks and leach fields;

   - vi. current and former oil and/or hazardous substance storage, fill/dispensing and disposal structures and/or areas;
   - vii. the location of any known spills, releases, discharges or disposal; and
   - viii. monitoring wells, borings, test pits and other sampling and screening points.

3. **Site History** - The site history should be presented in chronological order and should include a description of each period of ownership and use since the property was developed from pristine land. The following information should be provided:
   - a. Owner/Operator and Operations History
     - i. a list of current and previous owners and operators of the site including dates of ownership and operation; and
     - ii. a description of current and historical uses of the site including residential, commercial and industrial activities and manufacturing processes, and the location of buildings currently or previously located on the site.
   - b. Release History. A description of known releases at the site. For each release include the following information:
     - i. the source and location of the release;
     - ii. the known or suspected cause of the release;
     - iii. the known or approximate date and duration of the release;
     - iv. the type of material released;
     - v. the known or approximate volume of the release; and
     - vi. any measures taken to assess, contain or mitigate the release.
   - c. Oil and/or Hazardous Substance Use and Storage History. A description of all current and past use and storage of oil and/or hazardous substances at the site. This description should be based on at least all available written documentation and interviews with all former and current employees possessing relevant information. Include the following information:
     - i. types of oil and/or hazardous substances including generic names, chemical names and trade names, if available;
     - ii. uses of oil and/or hazardous substance;
     - iii. quantities used;
     - iv. periods of use;
     - v. on-site storage locations, underground storage tanks, aboveground storage tanks, drums, lagoons, pits and piles; and
     - vi. age and volume of tanks and other storage containers
   - d. Waste Management History. A general description of all known waste management practices excluding the off-site disposal of solid waste. Address the types of wastes or waste streams, and the locations of points of discharge or on-site disposal or treatment with respect to the following:
     - i. land disposal including landfills and lagoons;
     - ii. subsurface disposal including drains, septic systems and leach fields;
     - iii. surface water discharges to natural and man-made water bodies;
     - iv. discharges to wastewater treatment plants; and
     - v. any other means of disposal or treatment.

4. **Site Hydrogeological Characteristics.** A detailed description of subsurface investigations conducted at the site along with a comprehensive description and depiction of site hydrogeologic conditions including, without limitation:
    a. a description of all geologic, hydrologic, geophysical, and other subsurface investigations and assessments conducted at the site;
    b. documentation relating to borings, well construction and development, sample collection and analysis, and aquifer testing and analysis; and
    c. a detailed characterization of geologic and hydrologic conditions including groundwater potentiometric surface(s), gradients, flow rates, flow direction(s), and seasonal fluctuations
    d. soil type, stratigraphy and permeability; and
    e. where appropriate, bedrock type, characteristics and contours.

5. **Nature and Extent of Contamination.** A characterization of the source(s), nature and vertical and horizontal extent of contamination, presence and distribution of any non-aqueous phase liquids, tabulation of the analytical testing results, and, where appropriate, a characterization of background concentrations. Include an evaluation of all potential off-site sources of contamination.

6. **Environmental Fate and Transport of Contaminants.** Include as appropriate:
    a. an evaluation of the environmental fate and transport characteristics of the contaminants including mobility, stability, volatility, persistence and bioaccumulative potential;
    b. identification and characterization of existing and potential migration pathways of contaminants at and from the site, including as appropriate, air, soil, groundwater, surface water, sediment and food chain pathways; and
    c. an evaluation of the potential for groundwater to be a source of vapors of contaminants to the indoor air of occupied structures.
    d. complete documentation of environmental fate and transport computer modeling efforts. Please refer to Appendix 7 for groundwater modeling documentation requirements. Minimum documentation for modeling transport of contaminants to indoor air or soil contaminants to groundwater should include:
        i. the name, version and developer of the model;
        ii. the type of sites for which the model was designed and/or is applicable;
        iii. critical assumptions inherent to the model;
        iv. critical conceptual assumptions and estimates of input values made by the modeler;
        v. a description of the calibration process used by the modeler;
        vi. a description of the range of values used and the results of sensitivity analyses on critical data inputs to the model; and
        vii. a graphical representation and narrative explanation of the modeling results.

7. **Identification and Characterization of Potential Human and Environmental Receptors.** A characterization of all potential human and environmental receptors identified at the site and in the surrounding environment (within 1/4 mile the site boundaries).
    a. Identification of Human Receptors. Identify and describe the human receptors who are likely to be present at the site or in the surrounding environment, and who, as a result, would likely be exposed to contaminants. The following factors must be considered and included in identifying human receptors:

i. The current and reasonably foreseeable uses of the site and the surrounding environment (as identified pursuant to Section 8).

ii. The human receptors must be described in terms of groups of individuals and not specific individuals.

iii. Subpopulations which may be at increased risk due to increased sensitivity should be identified as distinct receptors. (Examples of these subpopulations include children and the elderly.)

iv. Subpopulations with particular behavior patterns or current or past exposures to chemicals in the environment should be identified as distinct receptors.

v. The human receptors should be described in terms of age group, occupation or other characteristics which will distinguish them from the general population. Examples include:

- lifelong residents at the site;
- trespassers;
- women of childbearing age;
- construction workers;
- children, ages one to six; and
- subsistent cultures

b. Identification of Environmental Receptors. Identify and describe the environmental receptors that are likely to be present at the site or in the surrounding environment and which as a result, would likely be exposed to contaminants.

i. Examples of such biota include, but are not limited:

- to wildlife, such as deer, fox and squirrel;
- fish and shellfish; and
- plants such as grasses and trees.

ii. Examples of such habitats include, but are not limited to:

- Areas of Critical Environmental Concern
- surface water;
- fresh and saltwater fisheries and fish habitat, including but not limited to shellfish areas; and
- wetlands

iii. Any Species of Concern, Threatened Species or Endangered Species which are known or likely to be located at the site or in the surrounding environment should be specifically identified as an environmental receptor.

8. Identification of Site Activities and Uses. An evaluation of all current and reasonably foreseeable uses and activities that could occur at the site and in the surrounding environment which could result in exposure to oil and hazardous material by human and/or environmental receptors. The following factors must be considered:

a. The remediating party should identify and describe the current site activities and uses associated with the land itself; structures in and on the land; and the groundwater, surface water, soil, sediment or other medium, which could result in the exposure of human and/or environmental receptors to contaminants. This evaluation must include consideration of activities which may not be occurring at the time of the evaluation, but which are consistent with the current use of the site and surrounding environment and may reasonably be expected to occur.

b. The reasonable foreseeable site activities and uses must include any possible activity or use that could occur in the future to the extent that such activity or use could result in exposures to human or environmental receptors that are greater than the exposures associated with the current site activities and uses. Written documentation of projected activities and use of the site and the surrounding environment (within 1/4 mile of the site boundaries), should be provided. This information may be obtained from local county and municipal planning offices, utility commissions, public water supply companies, and from the appropriate DEHNR division, such as the Divisions of Water Resources, Community Assistance and Coastal Management.

c. Examples of site activities and uses associated with human receptors include, without limitation:

- the use of a building as a residence, office or a store;
- the use of water as drinking water, for washing floors, or watering lawns;
- the use of the land for gardening or farming;
- the excavation of soil;
- recreational activities such as playing baseball, swimming, fishing and hiking;
- leisure activities such as sunbathing, picnicking, and entertaining; and
- subsistence fishing in surface water bodies.

d. Examples of site activities and uses associated with environmental receptors include, without limitation:

- foraging by domestic animals and wildlife;
- the cultivation or growth of crops or trees;
- the support of other plant, domestic animal or wildlife populations; and
- the seasonal use of a location for nesting or mating.

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